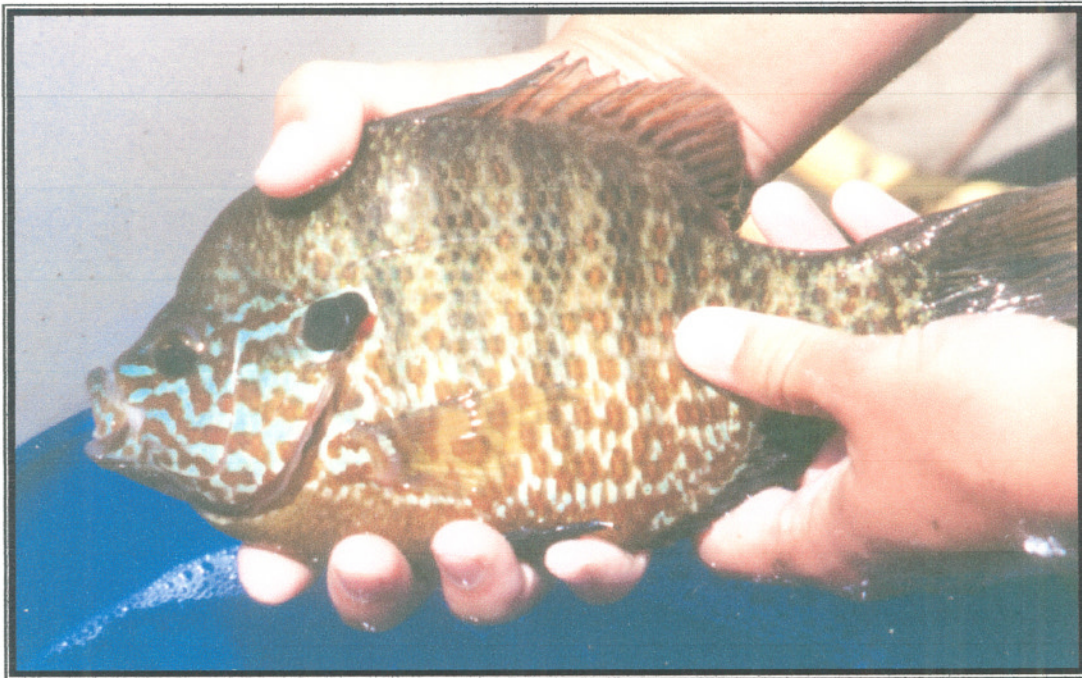


APPENDIX D

***FISH COMMUNITY MONITORING
ANNUAL REPORTS***

Elkhart Public Works & Utilities Fish Community Monitoring



Annual Report 2000

City of Elkhart 
The city with a heart

David L. Miller, Mayor

ANNUAL REPORT

Fish Community Monitoring on the St. Joseph and Elkhart Rivers and Selected Tributaries in Elkhart County, 2000.



**Joseph Foy
Aquatic Biologist
Elkhart Public Works & Utilities**

INTRODUCTION

For many years municipalities such as Elkhart have been required, through their NPDES (National Pollutant Discharge Elimination System) permits, to monitor chemical and microbiological levels of the rivers and streams to which they have any regulated discharges. This is done in an effort to protect the public and the aquatic communities that inhabit these waters, to determine the water quality in these areas, and to document the chemical and microbial contributions these discharges make to these streams. While conventional monitoring is good at identifying the chemical and microbial components of the water being tested and may help protect the public, it provides little information about the condition of the aquatic communities that it is also intended to protect. Alone, chemical and microbial monitoring is not an effective indicator of aquatic community health and provides limited insight to overall water quality.

To get a better idea of the impacts discharges may have on a stream, or what impact various land uses have in a stream's watershed, a two-tiered sampling approach has been found to be most effective in monitoring and determining water quality in aquatic systems and protecting aquatic communities (Craddock 1990, Ohio EPA 1988). These approaches use conventional monitoring coupled with biological monitoring, sampling of the actual aquatic communities. It is important to remember that conventional monitoring can only reveal the chemical and microbial levels of the water at the time the sample is collected. The sporadic presence of a biologically harmful substance could easily go undetected by conventional monitoring alone. Since the aquatic communities are present 24 hours a day, seven days a week, they are the overall product of the chemical and physical interactions in these aquatic systems and, hence, are the best indicators of the water quality in a given area. The drawback to biological monitoring, however, is it merely acts as a "red flag" when there is a problem. Since conventional monitoring can identify any problem chemical(s) and help pinpoint sources of contamination, it is best to use both monitoring strategies to provide the greatest amount of protection for the public and aquatic communities.

With this knowledge, the City of Elkhart began the second step in its monitoring activities by sampling the fish communities of the St. Joseph and Elkhart Rivers and their tributaries in and around Elkhart during the summer of 1998. In 1999 and 2000, core (Index) stations were resampled in an effort to establish baseline information that will allow the City to document the condition of the fish communities over time. This baseline of information will also reveal what impact an urban environment like Elkhart has on the rivers and streams that flow through it, and should identify any problem areas. The tool that will be used to assess the water quality using the fish community

information is the Index of Biotic Integrity (IBI) as modified by Thomas Simon (1997). This index was developed by James Karr (1981), and is most useful in translating complex fish community information into a more understandable format for non-biologists. In simplest terms, the IBI acts as a biological indicator much like the DOW Industrial Average acts as an economic indicator (Karr 1996) and it provides a method to track the trends in fish community condition over time. It is comprised of three broad categories (species composition, trophic composition, and fish condition) which are broken down into 12 smaller categories known as metrics (Appendix A) to assess fish communities. These metrics are each given a score of 1 (low), 3, or 5 (high), and the total score for a site is in the range of 12 to 60. These scores can then be graphed and placed into one of five categories which describes the overall condition of the fish communities. Since it is assumed that the condition of the fish communities is a reflection of the water quality in a given area, Elkhart will be able to effectively track water quality conditions over time.

In addition to determining the water quality in a number of streams, sampling was also conducted to determine the overall diversity of the fish species in the Elkhart area. A fish tagging program that included smallmouth bass (*Micropterus dolomieu*), largemouth bass (*Micropterus salmoides*) and walleye (*Stizostedion vitreum*) that were collected during biological monitoring activities was also continued. This tagging effort will assist the Indiana Department of Natural Resources (IDNR) in determining the movement patterns of walleye and alert fishermen to the City's monitoring activities. Scale samples were also taken from all walleye, smallmouth and largemouth bass over 75 mm in length for age and growth analysis. The scale data will be made available as an additional report at a later date. Finally, tissue from eight species of

fish was sampled and analyzed for mercury and PCB (polychlorinated biphenyl) content. This information was added to the existing tissue data that Elkhart has collected to compare to the state's fish consumption advisory for the St. Joseph and Elkhart Rivers. Presently several species are on this advisory in the Elkhart area (Table 1) and the City wants to verify the state's findings and contribute information to the existing state database so an accurate and thorough advisory can be issued.

Table 1: Fish consumption information taken from the 2000 Indiana Fish Consumption Advisory.

Location	Species	Fish Size (inches)	Contaminant	Group
Elkhart River	Rock Bass	7-9	Hg, PCB	3
		9+	Hg, PCB	4
	Smallmouth Bass	5-6	PCB	3
	White Sucker	8-13	PCB	3
		13+	PCB	4
St. Joseph River	Black Redhorse	13-17	Hg	2
		17+	Hg	3
	Channel Catfish	20-24	PCB	3
		25-26	PCB	4
		26+	PCB	5
	Golden Redhorse	13-25	PCB	3
		25+	PCB	4
	Largemouth Bass	11-12	Hg	2
		12+	Hg	3
	Rock Bass	7-9	PCB	3
		9+	PCB	4
	Shorthead Redhorse	14-17	Hg, PCB	3
		17+	Hg, PCB	4
	Smallmouth Bass	9-13	Hg	2
		13+	Hg	3
	Walleye	16-17	Hg	3
		17+	Hg	4

Hg = Mercury
PCB = PCBs

Group 2 = 1 meal/week
Group 3 = 1 meal/month

Group 4 = 1 meal/2 months
Group 5 = DO NOT EAT

(Special restrictions apply to women and children. See advisory.)

METHODS

In an effort to establish a baseline of information for future comparison, fish community information was collected at select sites each of the last three summers (1998-2000). The sampling efforts of 2000 marked the third and last annual sampling at the core sites visited by Elkhart. This sampling continued to identify the majority of fish species present and to determine water quality levels in the rivers and streams around Elkhart. Stream sites were again sampled in one of two ways. Investigative sites were sampled only once and all fish collected at these sites were identified to species, the largest and smallest of each species were measured to the nearest millimeter (mm), the fish were counted, and then released. Index sites, on the other hand, were sampled twice at five-week intervals, and the length of the sample area was dependent on the stream's width. The length of these sites was 15 times the stream's width with a minimum length of 50 meters and a maximum length of 500 meters. Fish collected at index sites were studied more extensively. These fish were

also identified to species and then processed in one of two ways. First, game fish (smallmouth bass, rock bass, bluegill, etc.) were measured by length to the nearest millimeter, individually weighed to the nearest gram (g), and then released. Non-game fish (suckers, darters, minnows, etc.) were counted, the largest and smallest of each species were measured to the nearest millimeter, species were mass weighed to the nearest gram, and then released. If a specimen of a species had not been previously retained from a site for the Public Works & Utilities specimen museum, then a single specimen of the smaller species was retained and larger specimens were photographed. This practice allows for the verification of the field and lab identifications if needed.

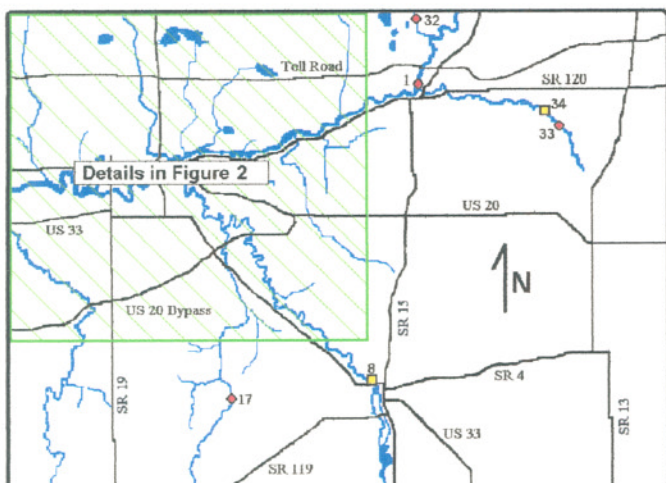
In 2000, the 20 index sites and 3 of the investigative sampled in 1998 and 1999 were resampled. In addition, eleven new investigative sites were also sampled (Figures 1 & 2 & Table 2). This continued Elkhart's sampling strategy of surveying the

Table 2: Sites sampled, the method used to sample each, and their IBI score (Index sites only).

Site Number	Site Description	Type of Site (Index/Investigative)	Method	IBI Scores			
				1998	1999	2000	Average
1	State Road 15 St. Joseph River	Index	Boat	53	57	51	54
2	County Road 17 St. Joseph River	Index	Boat	53	52	46	50
3	Mouth of Lily Creek St. Joseph River	Investigative	Boat				
4	Sherman Street St. Joseph River	Index	Boat	46	49	49	48
5	Bridge Street St. Joseph River	Index	Boat	48	50	48	49
6	Nappanee Street St. Joseph River	Index	Boat	48	48	48	48
7	Ash Road St. Joseph River	Investigative	Boat				
8	Rogers Park (below) Elkhart River	Investigative	Boat				
9	Oxbow Park Elkhart River	Index	Boat	52	54	53	53
10	County Road 18 Elkhart River	Index	Boat	52	52	52	52
11	Indiana Avenue Elkhart River	Index	Boat	45	47	51	48
12	Middlebury Street Elkhart River	Index	Boat	45	44	47	45
13	American Park Elkhart River	Index	Boat	48	45	48	47
14	Prairie Street Elkhart River	Investigative	Boat				
15	County Road 4 Christiana Creek	Index	Tote Barge	45	47	53	48
16	Willowdale Park Christiana Creek	Index	Tote Barge	46	46	41	44
17	County Road 32 Yellow Creek	Index	Tote Barge	36	34	37	36
18	US 20 Bypass Yellow Creek	Index	Tote Barge	44	43	29	39
19	County Road 28 Baugo Creek	Investigative	Tote Barge				
20	County Road 3 (N) Baugo Creek	Investigative	Tote Barge				
21*	County Road 10 Cobus Creek	Investigative	Tote Barge				
22*	County Road 8 Cobus Creek	Index	Tote Barge	34	28	29	30
23*	County Road 12 Cobus Creek	Investigative	Tote Barge				
24	Weaver Parkway Manning Ditch	Investigative	Back Pack				
25	County Road 12 Manning Ditch	Investigative	Back Pack				
26	Reckell Avenue Lily Creek	Index	Tote Barge	Not Sampled	32	38	
27	Bristol Street Lily Creek	Investigative	Tote Barge				
28*	County Road 8 Puterbaugh Creek	Index	Tote Barge	38	41	37	39
29*	US 20 Bypass Pine Creek	Index	Tote Barge	31	35	29	32
30*	County Road 17 Pine Creek	Investigative	Tote Barge				
31*	County Road 6 Washington Township Ditch	Investigative	Back Pack				
32	County Road 2 Trout Creek	Index	Tote Barge	Not Sampled	51	50	
33*	County Road 10 Little Elkhart River	Index	Tote Barge	Not Sampled	43	38	
34*	County Road 35 Little Elkhart River	Investigative	Tote Barge				

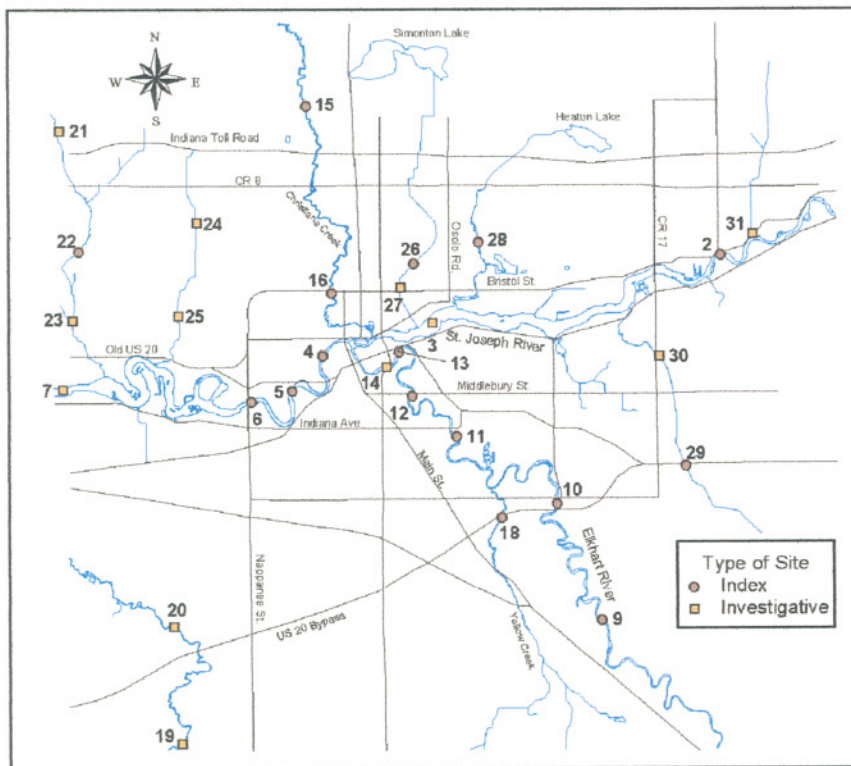
* - Denotes a cool/cold water stream

Figure 1: Fish sampling sites in Elkhart County, 2000.



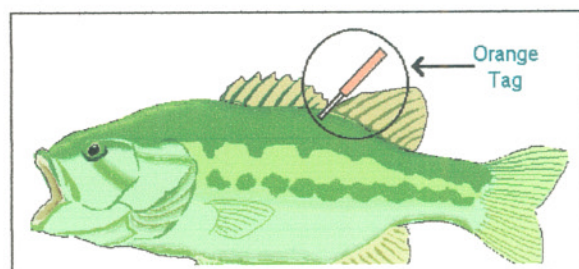
maximum number of streams and sites in the limited amount of time available for sampling. Investigative sites were generally sampled for a shorter distance (less than 15 times the stream width) and game fish other than bass and walleye that were individually measured at index sites were not weighed at these sites. These two differences in sampling and processing allowed for two investigative sites to be sampled in a day versus one index site.

Figure 2: Fish sampling sites in and around Elkhart, IN, 2000.



All sites were sampled utilizing either backpack, tote barge, or boat mounted electrofishing gear. The type of equipment used depended on the depth of the stream. For the smallest streams that would not accommodate the tote barge equipment, the battery powered backpack unit was used. If the stream was larger and wadeable for at least 80-90% of the area to be sampled, the tote barge equipment was used. All other areas were sampled utilizing the boat equipment. Power output of the three types of equipment varied. The backpack output was 0.5-1.5 amperes, the tote barge was 4-6 amperes, and the boat was 8-16 amperes.

Figure 3: Location of tag on fish.



Smallmouth bass greater than 10 inches, walleye greater than 12 inches and largemouth bass greater than 16 inches in length also had an anchor tag applied under the left anterior edge of the dorsal fin (Figure 3). This tag was orange or yellow in color and contained Elkhart Public Works & Utilities' phone number and a unique tag number. In addition to being tagged, the left pelvic fin of these fish was clipped to alert Public Works personnel to fish that had been tagged, but had shed the tag. The biggest advantage of this tagging study is its ability to reveal important movement patterns of these fish and help the IDNR in its walleye stocking efforts on the St. Joseph River. If the success of this stocking program continues

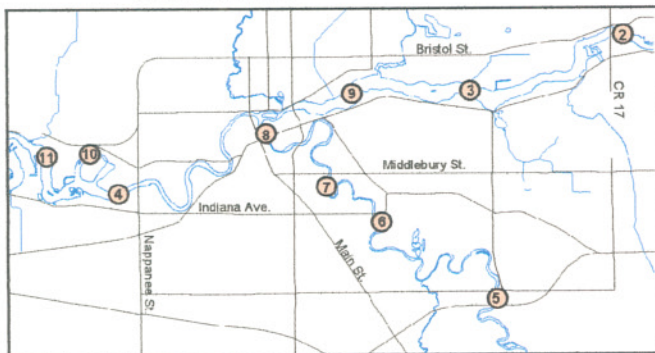
and grows, it could provide the Elkhart economy with additional revenue from non-local sport fishermen pursuing walleye in the Elkhart area.

Lastly, tissue in the form of fillets, was collected from common carp (*Cyprinus carpio*), smallmouth bass, rock bass (*Ambloplites rupestris*), walleye, channel catfish (*Ictalurus punctatus*), golden redhorse (*Moxostoma erythrurum*), shorthead redhorse (*M. macrolepidotum*), and white sucker (*Catostomus commersoni*) from July through October. The tissue samples were collected from four sites on the Elkhart River and six sites on the St. Joseph River (Table 3 & Figure 4). Due to the presence of an impassable dam just upstream of the Jackson Boulevard site on the Elkhart River, the tissue

Table 3: Fish tissue sites.

Site Number	River	Station
1	St. Joseph	Bristol (not on this map, same as Site 1 in Figure 1)
2	St. Joseph	Six-Span (CR 17)
3	St. Joseph	Bulldog Crossing (CR13)
4	St. Joseph	Below Nappanee St.
5	Elkhart	Hively Ave. (CR 18)
6	Elkhart	Indiana Ave.
7	Elkhart	Middlebury St.
8	Elkhart	Jackson Blvd.
9	St. Joseph	Martin's Landing
10	St. Joseph	Lexington Landing
11	St. Joseph	Oak Manor

Figure 4: Location of fish tissue sites on the St. Joseph and Elkhart Rivers.



samples collected from this area were once again treated as if the fish were from the St. Joseph River. Also, due to the difficulty of collecting three walleye of the same size from

any given site, the tissue sample for these fish was collected at three different locations. Each tissue sample sent in for analysis was a composite of tissue from three fish of the same species at the given site or area (except as noted above). The samples were collected following the procedures in Appendix B (this report) and Appendix III in "Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory" (1993).

RESULTS & DISCUSSION

In 2000, Elkhart collected 18,061 fish from the index and investigative sites that were sampled. These fish represented 66 species and 14 families (Tables 4 & 5). No additional species were found, leaving the species count for Elkhart County at 76. Greater redhorse (*Moxostoma valenciennesi* - state endangered) and river redhorse (*Moxostoma carinatum* - species of special concern) also continued to be represented in the samples. The top three species collected were mimic shiner (*Notropis volucellus*), white sucker, and smallmouth bass while the top three families represented were Cyprinidae (minnows and shiners), Catostomidae (suckers and redhorse), and Centrarchidae (sunfish and black bass). A summary of the species collected at each site is presented in Appendix C.

INDICES

The IBI scores ranged from a low of 29 (poor) at sites 18, 22 and 29 to a high of 53 (good) at sites 9 and 15 (Table 2). A longitudinal comparison of the 1998, 1999, and 2000 scores for the St. Joseph and Elkhart Rivers and Christiana and Yellow Creeks is presented in Graphs 1-3. It is important to remember that the IBI scores for the St. Joseph River (drainage basin >2,000 square miles) are only approximate because the metrics that were used were developed for rivers and streams in this area that have a drainage basin <1,000 square miles. When

Table 4: Summary of species captured at index sites.

Common Name	Total Number	% by Number	Total Weight (g)	Total Weight (lbs)	% by Weight
Mimic Shiner	1,956	13.82	2,445	5.39	0.10
Striped Shiner	1,329	9.39	19,482	42.91	0.83
Smallmouth Bass	1,162	8.21	182,968	403.01	7.76
White Sucker	1,127	7.96	174,294	383.91	7.39
Creek Chub	987	6.97	14,196	31.27	0.60
Golden Redhorse	956	6.76	575,956	1,268.63	24.43
Bluegill	923	6.52	28,305	62.35	1.20
Bluntnose Minnow	576	4.07	1,288	2.84	0.05
Rock Bass	575	4.06	47,661	104.98	2.02
Blacknose Dace	567	4.01	1,861	4.10	0.08
Spotfin Shiner	519	3.67	1,775	3.91	0.08
Northern Hog Sucker	494	3.49	106,148	233.81	4.50
Hornyhead Chub	400	2.83	8,650	19.05	0.37
Shorthead Redhorse	235	1.66	148,146	326.31	6.28
Mottled Sculpin	228	1.61	1,385	3.05	0.06
Stoneroller	180	1.27	1,587	3.50	0.07
Logperch	180	1.27	1,434	3.16	0.06
Johnny Darter	178	1.26	281	0.62	0.01
Rosyface Shiner	119	0.84	277	0.61	0.01
Silverjaw Minnow	111	0.78	207	0.46	0.01
River Redhorse	109	0.77	236,265	520.41	10.02
Largemouth Bass	106	0.75	21,385	47.10	0.91
Rainbow Darter	97	0.69	164	0.36	0.01
Common Carp	83	0.59	340,500	750.00	14.44
Yellow Bullhead	81	0.57	6,431	14.17	0.27
Quillback	71	0.50	105,433	232.23	4.47
Green Sunfish	68	0.48	1,846	4.07	0.08
Longear Sunfish	65	0.46	2,367	5.21	0.10
Walleye	64	0.45	14,207	31.29	0.60
Silver Redhorse	57	0.40	100,475	221.31	4.26
Spotted Sucker	54	0.38	19,782	43.57	0.84
Chestnut Lamprey	52	0.37	764	1.68	0.03
Brown Trout	42	0.30	4,758	10.48	0.20
Bowfin	32	0.23	45,869	101.03	1.95
Orangethroat Darter	29	0.20	31	0.07	0.00
Black Redhorse	28	0.20	19,853	43.73	0.84
Channel Catfish	26	0.18	52,955	116.64	2.25
Pumpkinseed	25	0.18	861	1.90	0.04
Blackside Darter	22	0.16	95	0.21	0.00
American Brook Lamprey	21	0.15	135	0.30	0.01
Grass Pickerel	19	0.13	727	1.60	0.03
Greater Redhorse	18	0.13	40,350	88.88	1.71
Black Crappie	18	0.13	2,794	6.15	0.12
Hybrid Sunfish	18	0.13	1,392	3.07	0.06
Tadpole Madtom	16	0.11	52	0.11	0.00
Stonecat	14	0.10	148	0.33	0.01
Yellow Perch	12	0.08	305	0.67	0.01
Steelcolor Shiner	12	0.08	38	0.08	0.00
Central Mudminnow	11	0.08	79	0.17	0.00
Brown Bullhead	9	0.06	3,822	8.42	0.16
Redear Sunfish	9	0.06	264	0.58	0.01
Sand Shiner	9	0.06	16	0.04	0.00
Northern Pike	8	0.06	8,152	17.96	0.35
Longnose Gar	8	0.06	4,438	9.78	0.19
Fathead Minnow	8	0.06	21	0.05	0.00
Rainbow Trout	7	0.05	2,366	5.21	0.10
River Chub	6	0.04	218	0.48	0.01
Warmouth	4	0.03	120	0.26	0.01
Brook Silverside	3	0.02	10	0.02	0.00
Common Shiner	3	0.02	8	0.02	0.00
Greenside Darter	2	0.01	11	0.02	0.00

Table 4 (cont.)

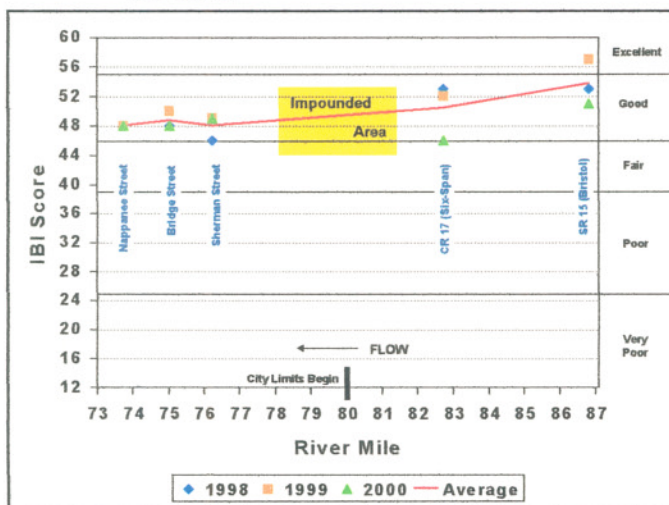
Common Name	Total Number	% by Number	Total Weight (g)	Total Weight (lbs)	% by Weight
Lake Chubsucker	1	0.01	12	0.03	0.00
Blackstripe Topminnow	1	0.01	3	0.01	0.00
Golden Shiner	1	0.01	1	0.00	0.00
Total	14,151	100.00	2,357,869	5,193.54	100.00

Table 5: Summary of species captured at investigative sites.

Common Name	Total Number	% by Number
White Sucker	479	12.25
Creek Chub	411	10.51
Golden Redhorse	372	9.51
Bluegill	320	8.18
Smallmouth Bass	317	8.11
Bluntnose Minnow	264	6.75
Mimic Shiner	217	5.55
Blacknose Dace	166	4.25
Stoneroller	155	3.96
Rock Bass	119	3.04
Striped Shiner	111	2.84
Silverjaw Minnow	88	2.25
Spotfin Shiner	88	2.25
Sand Shiner	81	2.07
Johnny Darter	77	1.97
Brown Trout	74	1.89
Mottled Sculpin	72	1.84
Green Sunfish	65	1.66
Spotted Sucker	65	1.66
Common Carp	42	1.07
Northern Hog Sucker	42	1.07
Largemouth Bass	41	1.05
Longear Sunfish	32	0.82
Spottail Shiner	20	0.51
Silver Redhorse	16	0.41
Walleye	16	0.41
Central Mudminnow	15	0.38
Grass Pickerel	15	0.38
Pumpkinseed	13	0.33
Chestnut Lamprey	11	0.28
Hybrid Sunfish	11	0.28
Yellow Bullhead	11	0.28
Shorthead Redhorse	9	0.23
Logperch	8	0.20
Greater Redhorse	7	0.18
Hornyhead Chub	7	0.18
Rainbow Darter	7	0.18
Redear Sunfish	7	0.18
Black Crappie	6	0.15
Rosyface Shiner	5	0.13
Yellow Perch	5	0.13
White Crappie	4	0.10
Channel Catfish	3	0.08
Northern Pike	3	0.08
Bowfin	2	0.05
Fathead Minnow	2	0.05
Rainbow Trout	2	0.05
American Brook Lamprey	1	0.03
Black Bullhead	1	0.03
Blackside Darter	1	0.03
Brook Silverside	1	0.03
Brown Bullhead	1	0.03
Longnose Dace	1	0.03
Stonecat	1	0.03
TOTAL	3,910	100.00

metrics are developed for the St. Joseph River, all previously collected information will be used to recalculate a more accurate IBI score. Index sites also could not be established in the impounded area of the St. Joseph River because the metrics were developed for flowing waters. The make-up of the fish community is greatly different in impounded areas due to the differences in habitats that are available.

Graph 1: IBI scores for the St. Joseph River, Elkhart County, 1998-2000.



Year-to-year IBI score fluctuations of 4-8 points are not unusual and are attributed to the natural variability of biological communities. The fluctuations in IBI scores for most of the sites sampled on the rivers and streams reflected this natural variability, except for the Yellow Creek US 20 Bypass site. A dramatic decrease in IBI scores (14 points) at this site indicated additional water chemistry monitoring in this area will be necessary to try to identify the cause.

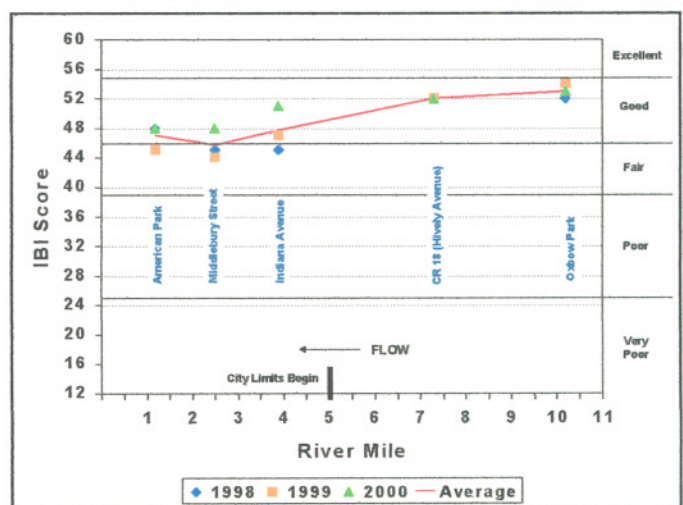
The trend of higher IBI scores upstream of Elkhart versus downstream on the St. Joseph River is reflected in the average scores for those sites for 1998-2000 (Graph 1). This trend is normal and, for now, expected. The multitude of impacts (ie. bridges, street runoff, combined sewer overflows, seawalls, lawn fertilizers, etc.) that are found in an urban area like Elkhart creates this trend in IBI scores. As improvements are made in

adjacent land-use practices by all people, and new technologies allow for cleaner effluents from all sources, this trend will ideally become less exaggerated in time. With all of the disturbances and impacts that this river receives, however, the condition of the fish community as reflected by the IBI scores remains above average for an urban area the size of Elkhart.

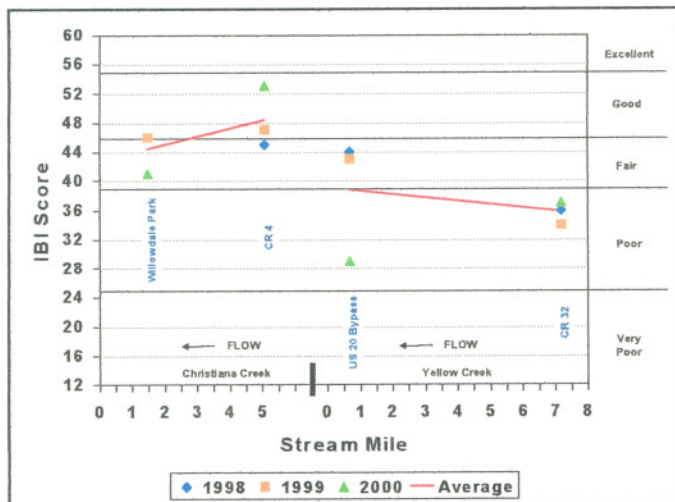
The trend of the Elkhart River IBI scores closely followed that of the St. Joseph River (Graph 2). The average of the scores from 1998-2000 was higher at the sites above Elkhart versus the sites within Elkhart. The IBI scores and the trends for both the Elkhart and St. Joseph Rivers do not reflect that the fish communities are in trouble, but do reveal that there is room for improvement for these communities through advances in technology and better stewardship activities.

Yellow Creek (tributary of the Elkhart River) and Christiana Creek (tributary of the St. Joseph River) were two of the largest tributaries sampled and each had two index sites. The County Road 32 site on Yellow Creek continued to reflect the poor water quality (Graph 3) that is common in streams impacted by agricultural runoff and stream channel modifications (ie. snagging and dredging). This site and the area upstream of it have tall, steep slopes, very little

Graph 2: IBI scores for the Elkhart River, Elkhart County, 1998-2000.



Graph 3: IBI scores for Christiana and Yellow Creeks, Elkhart County, 1998-2000.



overhanging vegetation, and no significant buffer zones (unmowed grassy areas). These characteristics contribute to the high amount of sediments this stream moves after a hard rain, and decreases the amount and types of habitats available to fish. The US 20 Bypass site previously revealed how a fish community could recover from most impacts if left undisturbed. This site and the immediate areas up and downstream have a great deal of overhead canopy and buffer strips and the stream channel has not been modified. All of these stream characteristics allow for a more diversified fish assemblage due to an increase in the amounts and types of habitats available. In 2000, however, the IBI scores at this site dropped dramatically revealing an impact by an unknown source. The habitat of this area had not changed, so the source is assumed to be a water contaminant. Water sample sites will be established upstream and within the fish sampling site to try to identify this contaminant and its source.

Christiana Creek flows through less agricultural land, but more residential areas than Yellow Creek. This trade-off has problems of its own, however. The presence of seawalls and septic systems, absence of buffer zones, and application of lawn fertilizers up to the stream's edge negatively impact this stream. The residential

development along this stream could greatly decrease the effects of these impacts by simply building fewer or no seawalls, leaving more buffer zones, dealing with problem or failing septic systems, and using little or no lawn chemicals near the stream's edge. The IBI scores reveal good biological integrity in the upper reaches with only a slight decrease as the stream enters the city.

The IBI scores for the six remaining streams that had an index site are displayed in Graph 4. The Little Elkhart River, Lily Creek and Trout Creek were not sampled in 1998 so no average scores were calculated for these sites.

Puterbaugh, Pine and Cobus Creeks as well as the Little Elkhart River all had a good variety of habitats available. The water temperature these streams maintain, however, classify them as cool/cold water streams and this is their biggest limiting factor. This is important to know because the IBI was developed and modified for use on warmwater streams. Cool/cold water streams tend to have fewer species and not as many fish as warmwater streams. When the IBI is used to assess cool/cold water streams, it generally scores them lower. To have the best understanding of the integrity of these stream resources, the IBI metrics would need

Graph 4: IBI scores for various streams, Elkhart County, 1998-2000.

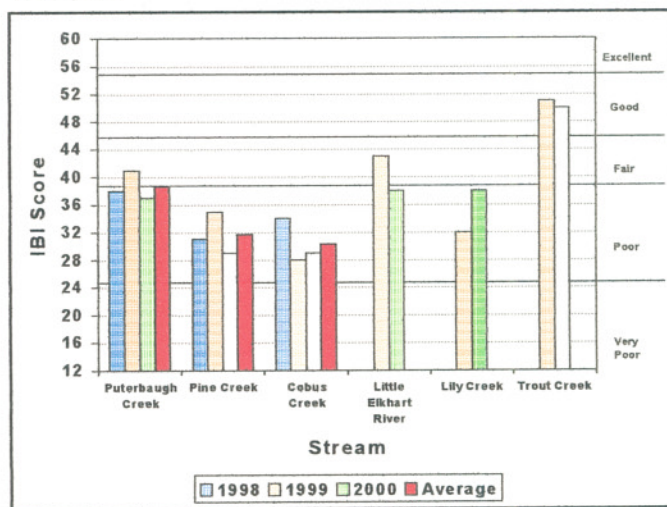


Table 6: Summary of tagged and recaptured fish.

Species	Number Tagged			Recaptures (fishermen)			Recaptures PW&U			# of Fish Represented		
	1998	1999	2000	1998	1999	2000	1998	1999	2000	1998	1999	2000
Smallmouth Bass	246	321	361	8	12	25	5	30	49	12	41	67
Walleye	38	41	40	4	4	8	0	0	3	4	4	10
Largemouth Bass	NA	17	20	NA	0	1	NA	0	3	NA	0	3

to be modified for scoring these types of streams. For now, the present IBI modification will suffice to reveal any drastic changes over time until the cool/cold-water metrics can be completed.

Lily Creek and Trout Creek are warm-water streams that both drain lakes, but are maintained quite differently. Lily Creek is a regulated drain that has recently (1997) been dredged. This dredging activity was done in an effort to decrease flooding impacts to neighboring landowners. Streams of this type may never support a biologically diverse fish community, but that is to be expected due to the main function (agricultural drainage) of the stream. Trout Creek, however, is a naturally flowing stream that has not been impacted by dredging activities. The IBI scores for both sites (Table 2, Figure 4) quickly reveal that streams with few or no disturbances support a more diverse fish community.

TAGGING & MOVEMENT

For 2000, a total of 421 fish were tagged (Table 6) and 80 fish were recaptured in 89 events. Almost twice as many recaptures were recorded for both fishermen and Public Works as compared to 1999. This is an excellent reflection of the sampling technique utilized by Public Works and cooperation of fishermen. Since 1998, 141 fish have been recaptured in 152 events, which reflects a recapture rate of 13.0% for all fish tagged to date. This recapture rate is good and reflects a slight increase in fishermen reporting recaptures, and a large

increase in the number of smallmouth bass recaptured by Public Works.

Of the 89 recapture events this year, only 17 revealed any type of fish movement (Table 7). Eleven of these movements were in an upstream direction, while the remaining six were in a downstream direction. Walleye were once again the most active in terms of relocating (8 out of 11 recaptures moved), while smallmouth bass tended to stay in the area of their initial capture (only 8 out of 74 recaptures moved). Five walleye moved an average of 5.1 miles upstream and three averaged 7.5 miles in a downstream direction. Five smallmouth bass also moved upstream an average of 4.8 miles and three moved downstream an average of 5.2 miles.

Table 7: Summary of movement of recaptured fish, 2000.

Direction Moved	Smallmouth Bass	Walleye	Largemouth Bass
No Movement	66	3	3
Upstream	5	5	1
Downstream	3	3	0

While the number of fish movements that were observed stayed about the same as in 1999, the pattern was completely different. Walleye moved both upstream and downstream, and were not just recaptured below dams. Likewise, the smallmouth bass that were recaptured had moved to completely different areas, not just back to their original capture zones.

FISH TISSUE

The fish tissue results from 1998 and 1999 found that modifications of the fish consumption advisory (FCA) were warranted in Elkhart County. In 2000, tissue samples were collected to help clarify 1998 and 1999 results and to add data to the walleye and channel catfish information that had been previously collected. Detailed results can be found in Appendix B.

Smallmouth bass from the Elkhart River that were within the size range of the FCA (5-6 inches) were tissue sampled for the first time by Public Works in 2000. The lab results revealed that these fish had group 1 mercury levels and group 2 PCB levels. These results for PCBs are lower than the state's previous findings. PCB levels in rock bass tissue from the Elkhart River continued to fluctuate. Each of the three sampling locations has now had rock bass tissue with PCB levels that fell within the group 1 or 2 advisory. While these results have varied slightly over the last three years, they still reveal PCB levels lower than previously reported by the state. The results for the white sucker tissue also varied, but revealed group 1 or 2 mercury levels and group 2 PCB levels.

Tissue sampling on the St. Joseph River focused on collecting larger channel catfish and walleye, and collecting additional tissue samples of golden redhorse, common carp, shorthead redhorse, and smallmouth bass to confirm previous results from certain sampling locations. These results indicate walleye 14 to 19 inches have group 2 mercury and PCB levels, and channel catfish over 26 inches have group 2 mercury levels and group 3 PCB levels. The results for these two species will have to be confirmed in the coming years. Golden redhorse tissue continued to fall within the group 2 mercury level above Elkhart and group 2 PCB levels below town. These results would still place golden redhorse in a lower advisory group than they are presently

in. Mercury and PCB results for carp continued to be lower than the state's findings, however carp tissue results for mercury have a similar pattern to the golden redhorse, higher above town than below town. Shorthead redhorse tissue results confirm the state's findings, and smallmouth bass results continued to vary. While smallmouth bass tissue results for mercury have revealed mostly group 1 levels, PCB results have varied from group 1 to group 3 levels showing a need for additional information.

CONCLUSION

After three years of conducting biological monitoring on the Elkhart and St. Joseph Rivers and their tributaries in Elkhart County, it has become apparent how important annual sampling is to accurately assess these rivers and streams and how useful annual sampling is in establishing a baseline for future comparisons. The IBI scores on the Elkhart and St. Joseph Rivers have fluctuated from year to year, however it is easy to see that these fluctuations are due to the natural variability of biological communities. While these IBI scores are reflective of good biological integrity, Graphs 1 and 2 point out that improvements could still be made. The fish communities of Christiana and Trout Creeks continue to exhibit good water quality, while Puterbaugh Creek and the Little Elkhart River have poor to fair water quality. An unknown impact has affected the fish community on the lower segment of Yellow Creek. This impact was noticed through a significant decrease in IBI scores at this site, and will be investigated further. Pine, Cobus and Lily Creeks continue to have poor water quality. The lower water quality of Lily and Yellow Creeks may be due to their primary use as agricultural drainage. The fish communities that were found may be the best that this type of stream can support. The fish communities found at the cool/cold-water streams (Puterbaugh, Pine and Cobus

Creeks and the Little Elkhart River) indicate lower water quality as determined by warmwater stream standards. Once the IBI metrics are developed and calibrated for the cool/cold-water streams in this area, a more accurate assessment will be available.

In Elkhart's third year of sampling, over 400 fish were tagged and 89 recaptures were recorded. While the number of recaptures drastically increased over previous years, the number of fish that actually moved remained about the same. Smallmouth bass moved very little (only 8 of 74), while 8 of 11 walleye moved either upstream or downstream. This information confirmed the walleye in this area are very mobile while the smallmouth bass tended to stay within very defined areas. This movement information, as well as the fish community information that is gathered, is helping the IDNR assess its stocking strategy for walleye. Elkhart looks forward to the continued stocking of walleye and the associated economic benefits for the city. The increased reporting of recaptured fish by fishermen has also given Elkhart the opportunity to inform more people of Elkhart's efforts to understand and protect its aquatic resources.

Fish tissue sampling results continued to support the need for modifications to the fish consumption advisory for Elkhart County. Additional data will be collected in 2001 for smaller smallmouth bass in the Elkhart River and larger walleye and channel catfish in the St. Joseph River to provide the best possible information on the status of PCB and mercury levels in these fish. Elkhart will also continue to provide its citizens with the most accurate information on PCB and mercury levels in the local fish populations.

In 2001, the City of Elkhart will continue its stewardship role in helping to preserve and protect the aquatic resources in this area as well as those in St. Joseph County. Beginning in the summer of 2001, the City of South Bend has contracted Elkhart to assist

them in data collection and understanding the fish communities and conditions of their aquatic resources. This joint effort will bring these two cities closer to truly understanding the health of the St. Joseph River as a watershed in Indiana. Both cities wish to protect and enhance their valuable aquatic resources for the future.

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Appendix A

Index of Biotic Integrity metrics

Index of Biotic Integrity metrics used to evaluate headwater stream (<20 square miles drainage area) sites in the St. Joseph River drainage:

1. Total number of species
2. Number of darter/madtom/sculpin species
3. % Headwater species
4. Number of minnow species
5. Number of sensitive species
6. % Tolerant
7. % Omnivores
8. % Insectivores
9. % Pioneer species (individuals)
10. Number of fish collected
11. % Simple lithophils
12. % DELT anomalies

Index of Biotic Integrity metrics used to evaluate wadeable stream (>20-<1,000 square miles drainage area) sites in the St. Joseph River drainage:

1. Total number of species
2. Number of darter species
3. Number of sunfish species
4. Number of sucker species
5. Number of sensitive species
6. % Tolerant
7. % Omnivores
8. % Insectivores
9. % Carnivores
10. Number of fish collected
11. % Simple lithophils
12. % DELT anomalies

Appendix B

Fish tissue preparation and results

Materials needed:

- Reynolds aluminum foil
- freezer wrap
- deionized (DI) water
- 1/2 gallon, 1 gallon, and jumbo size freezer bags w/write-on labels
- skinners
- stainless steel fillet knives
- knife sharpener
- scalars
- ice
- cooler

A group of three fish per species was selected based on size. In every case but one, the smallest fish in a group was greater than or equal to 90% of the length of the largest fish in that group. In the one instance the smallest fish was greater than 75% of the length of the largest fish as called for in the "Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory"(1993). The largest fish or fish that fell into a length range for species on the advisory were selected. The fish were kept as close in size as possible within a group because the tissue from the three fish in each group was composited (mixed together) before the analyses were completed.

All of the tissue was in the form of boneless fillets taken from the fish. All of the fish, except for a few carp and redhorse groups, had skin-on fillets taken. The few exceptions had skin-on fillets taken from one side of each fish and skin-off fillets taken from the opposite side. These skin-on composites were analyzed separate from the skin-off composites to note the differences that may occur due to the different preparations.

Before the tissue was removed, the fillet knives, scalars and skinners were cleaned and rinsed with DI water, and freezer wrap was placed where the fish were to be processed. The knives, scalars and skinners were washed in river water and rinsed with DI water after each species was processed and new freezer wrap was placed before another species was processed. For skin-on samples, the scales were removed before the fillet was taken. For skin-off samples, the skin was scored around the edge of the fillet and then removed before the fillet was taken. It was important to be consistent with where the cut of the fillet ended and to not include any of the body cavity or viscera. Once the fillets were removed, they were rinsed in river water and then rinsed with DI water before being placed on aluminum foil. The foil was large enough to hold the three fillets for each species at a site. When all three fillets were placed on the foil, it was then wrapped and placed in a labeled freezer bag and placed on ice in a cooler. The fish tissue was placed in a freezer upon returning to the lab, and kept frozen until sent to the contract lab for analyses.

Appendix B

Tissue results and comparison.

Stream	Species	Station	Length Range (PW&U)			Advisory Length Range (State)	Mercury Group (PW&U)			Advisory Mercury Group (State)	PCB Group (PW&U)			Advisory PCB Group (State)
			1998	1999	2000		1998	1999	2000		1998	1999	2000	
Elkhart River														
Rock Bass														
		Hively Avenue (CR 18)	7.0-7.3	7.9-8.7	7.4-8.2	7-9	1	1	NA	2	2	2	1	3
		Indiana Avenue	6.9-7.3	7.3-7.9	7.1-7.4	7-9	1	1	NA	2	1	1	2	3
		Middlebury Street	7.2-7.6	7.2-8.0	7.7-7.9	7-9	1	1	NA	2	1	2	1	3
Smallmouth Bass														
		Hively Avenue (CR 18)	15.0-15.6	11.1-11.9	5.6-5.9	5-6	2	1	1	1	2	2	2	3
		Indiana Avenue	11.9-14.0	14.4-14.8	5.7-6.1	5-6	2	2	1	1	2	2	2	3
		Middlebury Street	15.6-16.7	12.4-13.4	5.9-6.0	5-6	2	2	1	1	2	1	2	3
White Sucker														
		Hively Avenue (CR 18)	15.0-15.6	14.3-15.2	NS	13+	1	1	NS	1	2	2	NS	4
		Indiana Avenue	15.2-15.6	13.5-14.4	NS	13+	1	1	NS	1	2	2	NS	4
		Middlebury Street	14.1-14.7	15.2-16.1	14.2-14.4 15.0-15.2	13+	2	2	1	1	2	2	NA	4
St. Joseph River														
Channel Catfish														
		Jackson Street	16.3-17.7	16.1-16.6	NS	<20	1	1	NS	1	2	2	NS	1
		SR 15 (Bristol)	NS	NS	27.6-28.6	26+	NS	NS	2	1	NS	NS	3	5
Common Carp														
		Six-Span (CR 17)	31.1-32.1	26.6-27.4	NS	25+	1-2	2	NS	5	2	3	NS	5
		Bulldog Crossing (CR 13)	27.6-29.5	25.1-27.6	NS	25+	2	2	NS	5	3	3	NS	5
		Jackson Boulevard	25.6-26.1	25.2-27.8	NS	25+	1	1	NS	5	3	1-3	NS	5
		Nappanee Street	26.2-27.1	25.7-28.1	25.1-26.3	25+	1	1	1	5	3	3-4	3	5
Golden Redhorse														
		Six-Span (CR 17)	15.6-15.9	16.7-16.9	NS	13-25	1	2	NS	1	1	1	NS	3
		Bulldog Crossing (CR 13)	16.1-16.8	16.2-17.0	16.2-17.0	13-25	1	2	2	1	1	1	1	3
		Nappanee Street	15.2-15.7	14.7-14.9	14.9-16.1	13-25	1	1	1	1	2	2	2	3
Largemouth Bass														
		Six-Span (CR 17)	12.9-13.2	13.2-13.7	NS	12+	2	2	NS	3	1	1	NS	1

Appendix B

Stream	Species	Station	Length Range (PW&U)			Advisory Length Range (State)	Mercury Group (PW&U)			Advisory Mercury Group (State)	PCB Group (PW&U)			Advisory PCB Group (State)
			1998	1999	2000		1998	1999	2000		1998	1999	2000	
St. Joseph River (Continued)														
Shorthead Redhorse														
		Jackson Boulevard	15.5-16.9	16.0-16.6	15.0-15.7 16.4-16.9	14-17	1	1	NA	2	2	3	3	3
Smallmouth Bass														
		Bulldog Crossing (CR 13)	10.7-10.8	10.4-11.1	10.0-10.3 11.0-11.7	9-13	1	1	NA	2	1	3	1	1
		Jackson Boulevard	10.0-10.2	10.9-11.1	NS	9-13	1	1	NS	2	2	2	NS	1
		Nappanee Street	11.2-11.6	10.7-10.8	10.3-10.8	9-13	2	1	1	2	1	1	NA	1
Walleye														
		Miscellaneous Sites	NS	14.8-15.6	NS	<16	NS	2	NS	1	NS	2	NS	1
		Miscellaneous Sites	NS	NS	17.4-18.7	17+	NS	NS	2	4	NS	NS	2	1

NS - No sample collected

NA - No analysis performed

Appendix C

Location and species of fish caught at all sites in Elkhart County, 2000

Appendix C

Stream Site Number	St. Joseph River												
	1		2		3		4		5		6		7
	1st Pass	2nd Pass	1st Pass	2nd Pass	Day	Night	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	
Chestnut Lamprey	X	X	X	X					X	X			
American Brook Lamprey								X					
Longnose Gar	X		X				X		X	X	X		
Bowfin	X	X	X	X		X					X	X	
Rainbow Trout											X		
Grass Pickerel		X						X					
Northern Pike		X		X	X	X						X	
Common Carp	X	X	X	X	X	X	X	X	X	X	X	X	X
Rosyface Shiner			X				X	X			X		
Striped Shiner				X			X				X		
Spottail Shiner					X								X
Steelcolor Shiner				X									
Spotfin Shiner	X	X	X	X			X	X	X	X	X	X	X
Mimic Shiner	X	X	X	X			X	X	X	X	X	X	X
Bluntnose Minnow	X	X	X	X	X			X	X		X	X	X
Quillback							X		X	X	X	X	
Silver Redhorse	X		X	X	X	X	X	X	X	X	X	X	X
Black Redhorse	X		X	X			X	X	X		X		
Golden Redhorse	X	X	X	X	X	X	X	X	X	X	X	X	X
Shorthead Redhorse	X	X	X	X	X	X	X	X	X	X	X	X	X
Greater Redhorse								X		X		X	
River Redhorse			X	X			X	X	X	X	X	X	
Northern Hog Sucker	X	X	X	X			X	X	X	X	X		
White Sucker	X	X			X		X				X	X	X
Spotted Sucker	X	X	X		X	X					X	X	X
Channel Catfish	X	X			X		X	X		X		X	
Yellow Bullhead	X	X		X	X	X		X	X	X		X	
Brown Bullhead	X	X											X
Brook Silverside					X						X	X	
Black Crappie					X					X	X	X	X
Rock Bass	X	X	X	X	X	X	X	X	X	X	X	X	X
Smallmouth Bass	X	X	X	X	X	X	X	X	X	X	X	X	X
Largemouth Bass	X	X	X	X	X	X		X	X	X	X	X	X
Green Sunfish					X			X			X		
Hybrid Sunfish			X		X	X	X			X			
Bluegill	X	X	X	X	X	X	X	X	X	X	X	X	X
Longear Sunfish	X		X	X	X			X	X	X	X	X	X
Redear Sunfish										X	X		
Pumpkinseed			X	X	X	X			X	X		X	
Walleye	X	X	X		X	X	X	X	X	X	X	X	
Yellow Perch	X	X	X	X		X						X	
Blackside Darter		X	X					X					
Logperch	X	X		X		X	X	X	X	X	X	X	
Johnny Darter		X											
Greenside Darter							X						
Rainbow Darter							X			X			X

Appendix C

Stream	Elkhart River											
Site Number	8	9		10		11		12		13		14
		1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	
Chestnut Lamprey	X	X		X	X	X	X			X		
American Brook Lamprey				X		X	X	X				
Bowfin				X	X							
Grass Pickerel				X	X		X	X	X			X
Northern Pike	X		X	X	X						X	
Hornyhead Chub	X	X	X	X	X	X	X	X	X			
Creek Chub		X						X				
Rosyface Shiner	X	X	X	X	X	X	X	X	X	X	X	X
Redfin Shiner												
Striped Shiner	X	X	X	X	X	X	X	X	X	X	X	X
Common Shiner										X		
Steelcolor Shiner								X				
Spotfin Shiner	X	X	X	X	X	X	X		X	X	X	X
Sand Shiner								X			X	
Mimic Shiner	X											
Silverjaw Minnow								X				
Bluntnose Minnow	X	X	X	X	X	X	X	X	X	X	X	
Black Redhorse				X								
Golden Redhorse	X	X	X	X	X	X	X	X	X	X	X	X
Shorthead Redhorse											X	
Greater Redhorse	X	X	X	X						X		
River Redhorse				X		X		X				
Northern Hog Sucker	X	X	X	X	X	X	X	X	X	X	X	X
White Sucker	X	X	X	X	X	X	X	X	X	X	X	X
Spotted Sucker	X	X	X	X	X	X			X	X	X	X
Channel Catfish											X	
Yellow Bullhead				X	X	X	X		X	X	X	
Black Bullhead	X											
Stonecat			X									
White Crappie	X											
Black Crappie		X		X	X		X		X	X		X
Rock Bass	X	X	X	X	X	X	X	X	X	X	X	X
Smallmouth Bass	X	X	X	X	X	X	X	X	X	X	X	X
Largemouth Bass	X	X	X	X	X	X	X	X		X	X	X
Green Sunfish	X	X		X			X		X	X	X	
Hybrid Sunfish	X		X			X			X			X
Bluegill	X	X	X	X	X	X	X	X	X	X	X	X
Longear Sunfish	X	X	X	X	X	X				X		X
Redear Sunfish							X				X	X
Pumpkinseed		X			X	X					X	X
Blackside Darter		X	X	X		X	X	X	X			

Appendix C

Stream	Christiana Creek				Yellow Creek				Baugo Creek		Cobus Creek				Manning Ditch	
Site Number	15		16		17		18		19	20	21	22		23	24	25
	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass				1st Pass	2nd Pass			
Chestnut Lamprey	X															
American Brook Lamprey	X	X											X	X		
Longnose Gar	X															
Bowfin	X	X														
Brown Trout											X	X	X	X		
Central Mudminnow												X	X			
Grass Pickerel		X	X	X					X	X	X			X		
Common Carp	X			X					X							
Hornyhead Chub	X	X			X	X	X	X								
River Chub	X	X														
Creek Chub					X	X	X	X	X	X	X	X	X	X	X	X
Blacknose Dace					X	X		X		X	X	X	X	X		
Longnose Dace										X						
Striped Shiner	X	X		X	X	X	X	X	X	X						
Common Shiner												X				
Spotfin Shiner									X	X						
Sand Shiner									X	X						
Mimic Shiner						X										
Silverjaw Minnow					X	X			X	X						
Fathead Minnow					X	X			X							
Bluntnose Minnow	X	X	X		X	X	X	X	X	X					X	
Stoneroller					X	X		X	X	X						
Silver Redhorse	X			X												
Black Redhorse				X												
Golden Redhorse	X		X	X					X	X						
Northern Hog Sucker	X	X	X	X												
White Sucker	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Lake Chubsucker	X															
Channel Catfish									X							
Yellow Bullhead	X	X	X	X		X			X		X	X				
Brown Bullhead					X											
Stonecat		X		X						X						
Tadpole Madtom	X		X													
Black Crappie								X								
Rock Bass	X	X	X	X					X	X						
Smallmouth Bass	X	X	X	X			X	X		X						
Largemouth Bass	X	X		X		X		X	X	X		X				
Warmouth						X										
Green Sunfish			X		X	X	X	X	X	X	X					
Bluegill				X	X	X		X	X							
Redear Sunfish										X						
Pumpkinseed							X		X							
Blackside Darter									X							
Logperch		X		X						X						
Johnny Darter					X	X	X	X	X	X						
Rainbow Darter	X	X	X	X						X						
Orangethroat Darter	X	X		X												
Mottled Sculpin													X	X		

Appendix C

Stream	Lily Creek			Puterbaugh Creek		Pine Creek			Washington Twnshp. Ditch	Trout Creek		Little Elkhart River		
Site Number	26		27	28		29	30		31	32		33	34	
	1st Pass	2nd Pass		1st Pass	2nd Pass	1st Pass	2nd Pass			1st Pass	2nd Pass	1st Pass	2nd Pass	
Chestnut Lamprey												X		X
American Brook Lamprey												X	X	
Bowfin										X	X			
Brown Trout									X			X	X	X
Rainbow Trout												X	X	X
Central Mudminnow	X				X	X		X	X			X	X	
Grass Pickerel	X	X	X	X	X		X		X		X			
Common Carp														X
Golden Shiner		X												
Hornyhead Chub										X			X	X
Creek Chub	X	X	X	X	X	X	X	X	X	X		X	X	X
Blacknose Dace	X	X				X	X	X				X	X	X
Striped Shiner										X	X	X	X	X
Spotfin Shiner										X				
Sand Shiner		X												
Mimic Shiner	X		X							X				
Fathead Minnow														X
Bluntnose Minnow		X								X			X	X
Stoneroller	X	X	X	X	X								X	X
Golden Redhorse														X
Shorthead Redhorse											X			
Northern Hog Sucker										X	X	X	X	X
White Sucker	X	X	X	X	X	X	X	X	X		X	X	X	X
Spotted Sucker											X			
Yellow Bullhead	X		X							X	X			
Stonecat										X				
Tadpole Madtom										X	X			
Blackstripe Topminnow											X			
Rock Bass										X	X			
Smallmouth Bass											X			
Largemouth Bass							X			X	X	X	X	X
Warmouth												X		
Green Sunfish	X	X	X	X	X								X	X
Hybrid Sunfish	X		X		X						X			
Bluegill	X	X	X		X					X	X	X	X	X
Longear Sunfish										X				
Redear Sunfish				X							X			
Pumpkinseed				X							X			X
Walleye						X								
Yellow Perch			X								X			X
Logperch				X						X	X			
Johnny Darter	X	X		X	X	X	X	X				X	X	X
Greenside Darter										X				
Rainbow Darter				X	X				X	X	X			
Orangethroat Darter					X					X				
Mottled Sculpin				X	X	X	X	X	X			X	X	X

APPENDICES

Appendix A

Index of Biotic Integrity metrics

Index of Biotic Integrity metrics used to evaluate headwater stream (<20 square miles drainage area) sites in the St. Joseph River drainage:

1. Total number of species
2. Number of darter/madtom/sculpin species
3. % Headwater species
4. Number of minnow species
5. Number of sensitive species
6. % Tolerant
7. % Omnivores
8. % Insectivores
9. % Pioneer species (individuals)
10. Number of fish collected
11. % Simple lithophils
12. % DELT anomalies

Index of Biotic Integrity metrics used to evaluate wadeable stream (>20-<1,000 square miles drainage area) sites in the St. Joseph River drainage:

1. Total number of species
2. Number of darter species
3. Number of sunfish species
4. Number of sucker species
5. Number of sensitive species
6. % Tolerant
7. % Omnivores
8. % Insectivores
9. % Carnivores
10. Number of fish collected
11. % Simple lithophils
12. % DELT anomalies

Qualitative Habitat Evaluation Index categories and metrics used to evaluate sites in the St. Joseph River drainage:

1. Substrate
 - type
 - number of types present
 - origin
 - silt cover
 - extent of embeddedness
2. Instream Cover
 - type
 - amount
3. Channel Morphology
 - sinuosity
 - development
 - channelization
 - stability
4. Riparian Zone and Bank Erosion
 - riparian width
 - floodplain quality
 - bank erosion
5. Pool/Glide and Riffle/Run Quality
 - maximum pool depth
 - pool/riffle morphology
 - pool/riffle/run current velocity
 - riffle/run depth
 - riffle/run substrate
 - riffle/run embeddedness
6. Gradient

Appendix B

Fish tissue preparation and results

Materials needed:

- Reynolds aluminum foil
- freezer wrap
- deionized (DI) water
- 1/2 gallon, 1 gallon, and jumbo size freezer bags w/write-on labels
- skinners
- stainless steel fillet knives
- knife sharpener
- scalers
- ice
- cooler

A group of three fish per species was selected based on size. The smallest fish in each group was greater than or equal to 90% of the length of the largest fish in that group. The largest fish or fish that fell into a length range for species on the advisory were selected. The fish were kept as close in size as possible within a group because the tissue from the three fish in each group was composited (mixed together) before the analyses were completed.

All of the tissue was in the form of boneless fillets taken from the fish. All of the fish, except the channel catfish, had skin-on fillets taken. Before the tissue was removed, the fillet knives, scalers and skinners were cleaned and rinsed with DI water, and freezer wrap was placed where the fish were to be processed. The knives, scalers and skinners were washed in river water and rinsed with DI

water after each species was processed and new freezer wrap was placed before another species was processed. For skin-on samples, the scales were removed before the fillet was taken. For skin-off samples, the skin was scored around the edge of the fillet and then removed before the fillet was taken. It was important to be consistent with where the cut of the fillet ended and to not include any of the body cavity or viscera. Once the fillets were removed, they were rinsed in river water and then rinsed with DI water before being placed on aluminum foil. The foil was large enough to hold the three fillets for each species at a site. When all three fillets were placed on the foil, it was then wrapped and placed in a labeled freezer bag and placed on ice in a cooler. The fish tissue was placed in a freezer upon returning to the lab, and kept frozen until sent to the contract lab for analyses.

Fish Tissue Results

Stream	Species Year	Station	Length Range (inches, PW&U)	Advisory Length Range (State)	Mercury Group (PW&U)	Advisory Mercury Group (State)	PCB Group (PW&U)	Advisory PCB Group (State)
Elkhart River, Elkhart County								
	Golden Redhorse							
	2002	Oxbow Park (Below)	15.2-15.8	NONE	1	1	2	1
	2003	Oxbow Park (Below)	15.7-15.8	NONE	1	1	2	1
	2002	EEC (Above)	15.2-16.1	NONE	1	1	2	1
	2003	EEC (Above)	15.2-15.4	NONE	1	1	3	1
	Rock Bass							
	2001	Oxbow Park (Below)	7.0-7.6	7-9	---	2	1	2
	2002	Oxbow Park (Below)	7.1-7.8	7-9	1	2	1	2
	2003	Oxbow Park (Below)	7.4-7.7	7-9	1	1	1	2
	2001	EEC (Above)	7.0-7.6	7-9	---	2	3	2
	2002	EEC (Above)	7.7-8.3	7-9	1	2	1	2
	2003	EEC (Above)	6.9-7.3	7-9	1	1	2	2
	2001	Studebaker Park (Above)	7.1-7.8	7-9	---	2	1	2
St. Joseph River, Elkhart County								
	Black Redhorse							
	2001	Toll Road (Bristol)	17.8-17.9	17+	2	3	2	1
	2001	Lexington Avenue	17.6-18.2	17+	1	3	3	1
	2003	Lexington Avenue	17.8-18.1	17+	1	3	3	1
	Common Carp							
	2002	Toll Road (Bristol)	30.5-32.9	25+	2	5	3	5
	2003	Toll Road (Bristol)	30.9-33.3	28+	2	1	3	4
	2002	Lexington Avenue	29.4-31.1	25+	1	5	3	5
	2002	McNaughton Park	27.0-28.5	25+	1	5	3	5
	2001	Nappanee Street	26.6-27.1	25+	1	5	3	5
	2003	Nappanee Street	28.3-31.3	28+	1	1	2	4
	Largemouth Bass							
	2002	Nappanee Street	12.5-13.6	12+	2	3	1	1
	2003	Toll Road (Bristol)	13.5-15.0	13-14	2	2	1	1
	Rock Bass							
	2001	Toll Road (Bristol)	8.0-8.8	7-9	1	1	1	3
	2002	Toll Road (Bristol)	7.1-7.3	7-9	1	1	1	3
	2003	Toll Road (Bristol)	8.4-8.5	7+	1	2	1	1
	2001	Lexington Avenue	7.4-8.0	7-9	1	1	2	3
	2002	Lexington Avenue	7.9-8.1	7-9	1	1	1	3
	2003	Lexington Avenue	8.2-9.0	7+	1	2	1	1
	2001	McNaughton Park	7.4-7.8	7-9	1	1	1	3
	2002	McNaughton Park	7.3-7.4	7-9	1	1	2	3
	2003	McNaughton Park	7.6-7.9	7+	1	2	1	1

Fish Tissue Results

Stream	Species Year	Station	Length Range (inches, PW&U)	Advisory Length Range (State)	Mercury Group (PW&U)	Advisory Mercury Group (State)	PCB Group (PW&U)	Advisory PCB Group (State)
St. Joseph River, Elkhart County								
	Walleye							
	2000	Elkhart Area	17.4-18.7	17+	2	4	2	1
	2002	Bristol Area	17.2-17.9	17+	2	4	1	1
	2003	Bristol Area	16.1-16.4	16+	2	3	1	3
	2003	Bristol Area	19.3-19.9	16+	2	3	1	3
St. Joseph River, St. Joseph County								
	Black Redhorse							
	2001	Keller Park	15.9-16.6	14-17	1	2	1	3
	2003	Keller Park	17.2-18.1	16-18	1	1	4	3
	2003	Darden Road	16.1-16.6	16-18	1	1	4	3
	Channel Catfish							
	2003	Darden Road	26.1-28.7	22+	2	2	4	4
	Common Carp							
	2001	Ironwood Drive	31.9-33.1	20+	1	2	5	5
	2002	Ironwood Drive	31.6-32.6	20+	2	2	5	5
	2003	Ironwood Drive	29.7-32.4	20+	2	1	5	5
	2001	Jefferson Blvd.	30.4-32.4	20+	1	2	3	5
	2002	Veterans Park	29.9-30.9	20+	2	2	5	5
	2001	Keller Park	29.1-31.0	20+	1	2	4	5
	2002	Keller Park	30.9-31.4	20+	1	2	4	5
	2003	Keller Park	28.9-31.0	20+	1	1	5	5
	2001	Darden Road	25.7-27.8	20+	2	2	4	5
	2002	Darden Road	29.9-31.5	20+	2	2	5	5
	2003	Darden Road	28.3-30.1	20+	1	1	5	5
	Golden Redhorse							
	2001	Ironwood Drive	15.4-16.1	13-22	1	1	3	3
	2003	Ironwood Drive	17.8-18.2	13-22	1	1	3	3
	2001	Michigan Street	16.2-17.5	13-22	2	1	2	3
	2002	Michigan Street	17.6-17.8	13-22	2	1	3	3
	2003	Michigan Street	15.9-17.3	13-22	2	1	4	3
	2001	Darden Road	15.2-16.2	13-22	1	1	3	3
	2002	Darden Road	17.0-17.9	13-22	2	1	3	3
	2003	Darden Road	16.7-17.0	13-22	2	1	3	3
	Quillback							
	2002	Ironwood Drive	18.6-19.4	18+	2	1	4	3
	2003	Ironwood Drive	19.3-19.5	18+	2	1	3	3
	2003	Michigan Street	18.5-20.3	18+	2	1	4	3
	2002	Keller Park	19.0-20.2	18+	1	1	3	3
	2003	Keller Park	19.7-20.5	18+	1	1	3	3
	2001	Darden Road	19.7-20.0	18+	1	1	3	3
	2002	Darden Road	18.3-19.1	18+	2	1	3	3
	2003	Darden Road	18.8-19.6	18+	1	1	3	3

Fish Tissue Results

Stream	Species Year	Station	Length Range (inches, PW&U)	Advisory Length Range (State)	Mercury Group (PW&U)	Advisory Mercury Group (State)	PCB Group (PW&U)	Advisory PCB Group (State)
St. Joseph River, St. Joseph County								
	Shorthead Redhorse							
	2002	Ironwood Drive	17.5-18.0	15-19	2	2	4	3
	2003	Ironwood Drive	17.9-19.3	15-19	1	2	4	3
	2001	Michigan Street	16.5-17.3	15-19	2	2	4	3
	2002	Michigan Street	16.5-17.6	15-19	2	2	3	3
	2003	Michigan Street	17.6-18.4	15-19	2	2	5	3
	2001	Darden Road	17.3-18.1	15-19	2	2	4	3
	2002	Darden Road	17.6-18.2	15-19	2	2	3	3
	2003	Darden Road	17.9-18.1	15-19	2	2	4	3
	Smallmouth Bass							
	2001	Ironwood Drive	10.0-10.9	9+	1	2	3	3
	2002	Ironwood Drive	9.6-10.6	9+	1	2	3	3
	2003	Ironwood Drive	10.6-11.8	9+	1	2	2	3
	2001	Keller Park	10.3-10.8	9+	1	2	2	3
	2002	Keller Park	11.1-11.5	9+	1	2	3	3
	2003	Keller Park	11.3-12.4	9+	1	2	3	3
	2001	Darden Road	12.9-13.7	9+	2	2	1	3
	2002	Darden Road	10.7-11.3	9+	2	2	2	3
	2003	Brick Road	11.4-11.9	9+	1	2	3	3
	Steelhead							
	2001	Darden Road	26.3-28.6	26+	1	1	3	4
	2002	Darden Road	27.6-28.1	26+	2	1	3	4
	2003	Darden Road	25.6-27.2	26+	1	1	3	4
	White Sucker							
	2003	Ironwood Drive	15.4-16.5	14-16	1	1	3	3
	2002	Veterans Park	15.9-17.4	16+	2	1	3	4
	2001	Jefferson Boulevard	14.8-15.1	14-16	1	1	3	3
	2001	Jefferson Boulevard	16.6-17.8	16+	1	1	3	4
	2002	Jefferson Boulevard	14.3-14.8	14-16	1	1	3	3
	2001	Darden Road	16.9-17.9	16+	1	1	3	4
	2002	Darden Road	16.5-17.6	16+	2	1	3	4
	2003	Darden Road	14.8-15.9	14-16	1	1	3	3
	2003	Darden Road	16.3-17.9	16+	1	1	3	4
Juday Creek, St. Joseph County								
	White Sucker							
	2001	SR 23	14.4-14.8	12-17	1	1	1	2
	2003	SR 23	14.3-15.5	12-17	1	1	1	2
	2002	Douglas Road	12.9-14.2	12-17	1	1	1	2

Appendix C

Summary of fish collected by county, 2003

Summary of species captured at index sites in Elkhart County, 2003

Common Name	Total Number	% by Number	Total Weight (g)	Total Weight (lbs)	% by Weight
White Sucker	1,763	11.94	146,320	322.29	9.38
Mimic Shiner	1,534	10.39	2,367	5.21	0.15
Common Shiner	1,338	9.06	19,241	42.38	1.23
Creek Chub	1,038	7.03	11,741	25.86	0.75
Rock Bass	1,014	6.87	76,802	169.17	4.92
Smallmouth Bass	965	6.53	117,229	258.21	7.51
Bluegill	868	5.88	21,513	47.39	1.38
Hornyhead Chub	804	5.44	17,337	38.19	1.11
Striped Shiner	705	4.77	13,098	28.85	0.84
Blacknose Dace	559	3.78	2,682	5.91	0.17
Golden Redhorse	472	3.20	304,230	670.11	19.50
Northern Hog Sucker	369	2.50	64,904	142.96	4.16
Spotfin Shiner	351	2.38	1,923	4.24	0.12
Bluntnose Minnow	336	2.27	1,283	2.83	0.08
Mottled Sculpin	310	2.10	2,042	4.50	0.13
Johnny Darter	251	1.70	382	0.84	0.02
Logperch	203	1.37	1,780	3.92	0.11
Stoneroller, Central	163	1.10	1,873	4.13	0.12
Green Sunfish	150	1.02	3,269	7.20	0.21
Longear Sunfish	145	0.98	4,340	9.56	0.28
Chestnut Lamprey	138	0.93	1,503	3.31	0.10
Largemouth Bass	122	0.83	21,268	46.85	1.36
River Chub	111	0.75	1,568	3.45	0.10
Shorthead Redhorse	109	0.74	72,818	160.39	4.67
Blackside Darter	84	0.57	244	0.54	0.02
Common Carp	79	0.53	323,199	711.89	20.71
Rosyface Shiner	68	0.46	195	0.43	0.01
Fathead Minnow	58	0.39	225	0.50	0.01
Spotted Sucker	55	0.37	17,878	39.38	1.15
Yellow Bullhead	55	0.37	4,506	9.93	0.29
River Redhorse	51	0.35	130,924	288.38	8.39
Silver Redhorse	48	0.32	74,700	164.54	4.79
Brown Trout	47	0.32	3,799	8.37	0.24
Silverjaw Minnow	42	0.28	81	0.18	0.01
Grass Pickerel	36	0.24	559	1.23	0.04
Black Crappie	32	0.22	2,849	6.28	0.18
Redear Sunfish	29	0.20	1,894	4.17	0.12
Rainbow Darter	28	0.19	54	0.12	0.00
Steelcolor Shiner	26	0.18	145	0.32	0.01
Walleye	20	0.14	8,449	18.61	0.54
Sand Shiner	19	0.13	30	0.07	0.00
Central Mudminnow	16	0.11	107	0.24	0.01
Hybrid Sunfish	15	0.10	890	1.96	0.06
Pumpkinseed	15	0.10	402	0.89	0.03
Orangethroat Darter	14	0.09	14	0.03	0.00
Warmouth	12	0.08	215	0.47	0.01
Black Redhorse	11	0.07	9,137	20.13	0.59
Greater Redhorse	10	0.07	16,681	36.74	1.07
Yellow Perch	10	0.07	201	0.44	0.01
Quillback	9	0.06	11,408	25.13	0.73
Bowfin	8	0.05	14,767	32.53	0.95
Channel Catfish	8	0.05	11,749	25.88	0.75
Tadpole Madtom	8	0.05	62	0.14	0.00
Brown Bullhead	6	0.04	4,058	8.94	0.26
Longnose Gar	6	0.04	3,600	7.93	0.23
Black Bullhead	6	0.04	1,084	2.39	0.07
Stonecat	5	0.03	155	0.34	0.01
American Brook Lamprey	4	0.03	31	0.07	0.00
Brook Silverside	4	0.03	16	0.04	0.00
Rainbow Trout	3	0.02	790	1.74	0.05
Northern Pike	2	0.01	3,650	8.04	0.23
Longnose Dace	1	0.01	16	0.04	0.00
Pirate Perch	1	0.01	14	0.03	0.00
Brook Stickleback	1	0.01	2	0.00	0.00
Sub-Total	14,770	100.00	1,560,293	3,436.83	100.00

Summary of species captured at investigative sites in Elkhart County, 2003

Common Name	Total Number	% by Number
White Sucker	1,139	12.12
Creek Chub	862	9.17
Bluegill	630	6.70
Blacknose Dace	593	6.31
Rock Bass	547	5.82
Smallmouth Bass	532	5.66
Fathead Minnow	451	4.80
Golden Redhorse	407	4.33
Green Sunfish	353	3.76
Bluntnose Minnow	327	3.48
Common Shiner	299	3.18
Mimic Shiner	289	3.07
Sand Shiner	289	3.07
Hornyhead Chub	220	2.34
Silverjaw Minnow	202	2.15
Mottled Sculpin	197	2.10
Longear Sunfish	184	1.96
Spotfin Shiner	183	1.95
Common Carp	162	1.72
Striped Shiner	146	1.55
Johnny Darter	134	1.43
Stoneroller, Central	119	1.27
Northern Hog Sucker	110	1.17
Spotted Sucker	110	1.17
Shorthead Redhorse	97	1.03
Largemouth Bass	88	0.94
Central Mudminnow	86	0.91
Loggerhead	85	0.90
Blackside Darter	48	0.51
Chestnut Lamprey	47	0.50
Walleye	44	0.47
Brown Trout	38	0.40
Silver Redhorse	37	0.39
Grass Pickerel	35	0.37
Rosyface Shiner	33	0.35
Pirate Perch	32	0.34
Gizzard Shad	26	0.28
Yellow Bullhead	23	0.24
Brook Silverside	22	0.23
Channel Catfish	20	0.21
Black Crappie	18	0.19
Rainbow Darter	15	0.16
Longnose Gar	14	0.15
Pumpkinseed	14	0.15
Hybrid Sunfish	12	0.13
Northern Pike	10	0.11
Rainbow Trout	10	0.11
Quillback	9	0.10
River Redhorse	7	0.07
Greater Redhorse	6	0.06
Emerald Shiner	5	0.05
Black Redhorse	4	0.04
Blackstripe Topminnow	4	0.04
Redear Sunfish	4	0.04
Bowfin	3	0.03
Orangethroat Darter	3	0.03
Spottail Shiner	3	0.03
Stonecat	3	0.03
Warmouth	3	0.03
American Brook Lamprey	2	0.02
Spotted Gar	2	0.02
Steelcolor Shiner	2	0.02
Brook Stickleback	1	0.01
Sub-total	9,400	100.00

Index Sites	14,770
Investigative Sites	9,400
Elkhart County Total	24,170

Summary of species captured at index sites in St. Joseph County, 2003

Common Name	Total Number	% by Number	Total Weight (g)	Total Weight (lbs)	% by Weight
Smallmouth Bass	551	12.84	65,269	143.76	4.08
Creek Chub	499	11.63	6,908	15.22	0.43
Mimic Shiner	498	11.61	757	1.67	0.05
Golden Redhorse	406	9.46	285,700	629.30	17.84
Longear Sunfish	357	8.32	15,420	33.96	0.96
Rock Bass	328	7.65	28,048	61.78	1.75
Shorthead Redhorse	220	5.13	180,632	397.87	11.28
Bluegill	185	4.31	5,949	13.10	0.37
White Sucker	176	4.10	43,567	95.96	2.72
Common Carp	122	2.84	568,401	1,251.98	35.49
Quillback	122	2.84	173,450	382.05	10.83
Mottled Sculpin	94	2.19	631	1.39	0.04
Northern Hog Sucker	86	2.00	26,802	59.04	1.67
Green Sunfish	80	1.86	2,524	5.56	0.16
Spotfin Shiner	72	1.68	318	0.70	0.02
Blacknose Dace	70	1.63	310	0.68	0.02
Rainbow Trout	56	1.31	20,143	44.37	1.26
Bluntnose Minnow	51	1.19	115	0.25	0.01
Silver Redhorse	42	0.98	78,194	172.23	4.88
Walleye	41	0.96	17,179	37.84	1.07
Black Redhorse	36	0.84	22,125	48.73	1.38
Pumpkinseed	34	0.79	1,240	2.73	0.08
Yellow Bullhead	29	0.68	4,900	10.79	0.31
Largemouth Bass	22	0.51	2,530	5.57	0.16
Logperch	21	0.49	376	0.83	0.02
Chestnut Lamprey	16	0.37	225	0.50	0.01
Spotted Sucker	11	0.26	5,724	12.61	0.36
Johnny Darter	11	0.26	10	0.02	0.00
Longnose Gar	9	0.21	10,181	22.43	0.64
Hybrid Sunfish	9	0.21	785	1.73	0.05
Channel Catfish	4	0.09	11,896	26.20	0.74
River Redhorse	3	0.07	7,850	17.29	0.49
Greater Redhorse	3	0.07	5,417	11.93	0.34
Brown Trout	3	0.07	666	1.47	0.04
Steelcolor Shiner	3	0.07	13	0.03	0.00
Rainbow Darter	3	0.07	10	0.02	0.00
Sand Shiner	3	0.07	7	0.02	0.00
Bowfin	2	0.05	3,350	7.38	0.21
Brown Bullhead	2	0.05	1,190	2.62	0.07
Black Crappie	2	0.05	313	0.69	0.02
Gizzard Shad	2	0.05	1	0.00	0.00
Northern Pike	1	0.02	1,950	4.30	0.12
Goldfish	1	0.02	290	0.64	0.02
White Crappie	1	0.02	180	0.40	0.01
Striped Shiner	1	0.02	14	0.03	0.00
Spottail Shiner	1	0.02	5	0.01	0.00
Blackside Darter	1	0.02	3	0.01	0.00
Sub-Total	4,290	100.00	1,601,568	3,527.69	100.00

Summary of species captured at investigative sites in St. Joseph County, 2003

Common Name	Total Number	% by Number
Smallmouth Bass	376	18.28
Longear Sunfish	367	17.84
Creek Chub	240	11.67
Golden Redhorse	184	8.95
Rock Bass	134	6.51
Blacknose Dace	109	5.30
Spotfin Shiner	92	4.47
Common Carp	71	3.45
White Sucker	71	3.45
Bluegill	60	2.92
Mottled Sculpin	49	2.38
Shorthead Redhorse	48	2.33
Mimic Shiner	43	2.09
Quillback	38	1.85
Green Sunfish	23	1.12
Largemouth Bass	18	0.88
Pumpkinseed	16	0.78
Black Redhorse	15	0.73
Chestnut Lamprey	13	0.63
Northern Hog Sucker	13	0.63
Yellow Bullhead	13	0.63
Walleye	9	0.44
Rainbow Trout	8	0.39
Spotted Sucker	8	0.39
Johnny Darter	6	0.29
Silver Redhorse	5	0.24
Blackside Darter	4	0.19
Bluntnose Minnow	4	0.19
Logperch	3	0.15
Orangethroat Darter	3	0.15
Steelcolor Shiner	3	0.15
Spottail Shiner	2	0.10
Brook Silverside	1	0.05
Brown Trout	1	0.05
Channel Catfish	1	0.05
Emerald Shiner	1	0.05
Greater Redhorse	1	0.05
Longnose Gar	1	0.05
Rainbow Darter	1	0.05
Stonecat	1	0.05
Warmouth	1	0.05
Sub-total	2,057	100.00

Index Sites	4,290
Investigative Sites	<u>2,057</u>
St. Joseph County Total	6,347

Appendix D

Summary of fish collected by site, 2003

Stream	St. Joseph River, Elkhart County												
Site Number	1		2	3		4	5		6		7		8
	1st Pass	2nd Pass		1st Pass	2nd Pass		1st Pass	2nd Pass	1st Pass	2nd Pass	Day	Night	
▲ American Brook Lamprey						X							
● Black Bullhead	X												
Black Crappie		X		X	X	X	X	X	X		X	X	X
▲ Black Redhorse		X	X	X			X	X					
Blackside Darter	X			X	X		X	X	X			X	
Bluegill	X	X	X	X	X	X	X	X	X	X	X	X	X
● Bluntnose Minnow	X		X	X	X		X				X	X	X
Bowfin	X	X		X							X	X	
Brook Silverside						X	X					X	
Brown Bullhead	X	X		X									
● Channel Catfish		X	X			X		X		X		X	X
Chestnut Lamprey	X	X	X	X	X	X	X	X	X	X		X	
● Common Carp	X	X	X	X	X	X	X	X	X	X	X	X	X
Common Shiner								X					
Emerald Shiner											X	X	X
● Gizzard Shad						X							
Golden Redhorse	X	X	X	X	X	X	X	X	X	X	X	X	X
Grass Pickerel		X				X	X	X					
▲ Greater Redhorse									X	X			
● Green Sunfish			X	X	X		X	X	X	X			
▲ Hornyhead Chub	X												
Hybrid Sunfish			X	X			X			X	X	X	
Johnny Darter	X	X											
Largemouth Bass	X	X	X	X	X	X	X	X		X	X	X	X
Logperch	X	X	X	X	X	X	X	X	X	X		X	X
Longear Sunfish	X	X	X	X	X	X	X	X	X	X	X	X	X
Longnose Dace													
● Longnose Gar			X	X					X		X	X	
▲ Mimic Shiner	X	X	X	X	X	X	X	X	X		X	X	X
Northern Hog Sucker	X	X	X	X	X		X	X	X		X		
Northern Pike			X	X		X		X				X	
Orangethroat Darter					X			X					
Pumpkinseed							X	X			X	X	X
● Quillback							X		X	X	X	X	X
Rainbow Darter	X				X			X					
Rainbow Trout									X				
Redear Sunfish		X											
▲ River Redhorse	X	X	X	X	X		X	X	X	X		X	
Rock Bass	X	X	X	X	X	X	X	X	X	X	X	X	X
▲ Rosyface Shiner							X						
Sand Shiner	X										X	X	X
Shorthead Redhorse	X	X	X	X	X	X	X	X	X	X	X	X	
Silver Redhorse	X	X	X	X	X	X	X	X	X	X	X	X	X
Smallmouth Bass	X	X	X	X	X	X	X	X	X	X	X	X	X
Spotfin Shiner	X	X	X	X	X	X	X	X	X	X	X	X	X
Spottail Shiner													X
Spotted Gar			X								X		
Spotted Sucker	X	X		X	X	X					X	X	X
Steelcolor Shiner		X	X	X	X		X						
▲ Stonecat								X					
Striped Shiner							X	X				X	X
Walleye			X	X		X	X	X	X		X	X	
Warmouth		X	X							X		X	
● White Sucker				X		X		X	X	X	X	X	X
Yellow Bullhead		X	X		X	X				X			X
Yellow Perch					X								

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Stream	St. Joseph River, St. Joseph County														
Site Number	9		10		11		12		13	14		15		16	
	1st Pass	2nd Pass	1st Pass	2nd Pass	Night	Day	1st Pass	2nd Pass		1st Pass	2nd Pass	1st Pass	2nd Pass		
Black Crappie										X					
▲ Black Redhorse			X				X		X	X	X	X	X	X	
Blackside Darter					X	X					X				
Bluegill	X	X		X	X	X	X	X	X	X	X	X	X	X	
● Bluntnose Minnow	X	X	X	X					X	X	X			X	
Bowfin	X												X		
Brook Silverside						X									
Brown Bullhead	X														
● Channel Catfish		X									X		X	X	
Chestnut Lamprey			X			X	X		X	X	X	X	X	X	
● Common Carp	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Emerald Shiner						X									
● Gizzard Shad		X													
Golden Redhorse	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
● Goldfish											X				
▲ Greater Redhorse			X						X			X	X		
● Green Sunfish	X	X	X	X	X	X		X			X			X	
Hybrid Sunfish	X	X	X												
Johnny Darter									X						
Largemouth Bass	X	X	X					X	X	X	X		X	X	
Logperch							X	X	X		X	X	X	X	
Longear Sunfish	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
● Longnose Gar				X		X	X			X	X				
▲ Mimic Shiner	X	X		X		X			X	X	X	X	X	X	
Northern Hog Sucker							X	X	X	X	X	X	X	X	
Northern Pike										X					
Pumpkinseed	X	X	X	X		X		X	X	X	X		X	X	
● Quillback	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Rainbow Darter									X						
Rainbow Trout	X		X	X	X		X			X		X	X		
▲ River Redhorse								X			X				
Rock Bass	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Sand Shiner										X					
Shorthead Redhorse	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Silver Redhorse	X	X	X	X		X	X		X	X	X	X	X	X	
Smallmouth Bass	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Spotfin Shiner	X	X	X	X		X	X		X	X	X	X	X	X	
Spottail Shiner		X												X	
Spotted Sucker	X	X	X	X	X	X				X				X	
Steelcolor Shiner			X			X	X	X							
▲ Stonecat					X										
Striped Shiner													X		
Walleye	X		X	X		X	X	X	X	X	X	X	X	X	
Warmouth														X	
White Crappie										X					
● White Sucker	X	X	X	X	X		X		X	X	X	X	X	X	
Yellow Bullhead	X	X	X	X	X	X	X	X	X			X	X		

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Stream	Little Elkhart River						Rowe-Eden Ditch	Pine Creek				
Site Number	17	18		19		20	21	22	23	24	25	
		1st Pass	2nd Pass	1st Pass	2nd Pass						1st Pass	2nd Pass
▲ American Brook Lamprey		X								X		
▲ Black Redhorse												X
● Blacknose Dace	X	X	X				X	X	X	X	X	X
Blackside Darter				X	X	X					X	X
Bluegill	X	X	X	X	X	X		X	X	X	X	X
● Bluntnose Minnow	X	X	X			X						
Brook Silverside		X										
Brown Trout	X	X	X	X	X	X	X					
● Central Mudminnow	X	X	X		X		X		X	X	X	X
Chestnut Lamprey	X	X	X	X	X	X	X					
● Common Carp		X										
Common Shiner	X		X	X	X		X					
● Creek Chub	X	X	X	X	X		X	X	X	X	X	
Golden Redhorse			X		X	X						
Grass Pickerel	X	X				X	X		X	X		X
● Green Sunfish	X	X	X	X	X	X	X			X		X
▲ Hornyhead Chub			X									
Hybrid Sunfish											X	
Johnny Darter	X	X	X		X	X	X	X	X		X	X
Largemouth Bass		X	X	X	X	X						
Logperch			X	X	X	X					X	X
Mottled Sculpin	X	X	X	X	X	X	X	X	X	X	X	X
Northern Hog Sucker	X	X	X	X	X	X	X				X	X
Orangethroat Darter						X						
Pumpkinseed			X									
Rainbow Darter				X	X						X	X
Rainbow Trout				X		X	X					
Rock Bass				X	X	X						X
▲ Rosyface Shiner					X							
Sand Shiner						X						
Shorthead Redhorse		X		X	X	X						
Silver Redhorse				X	X							
Smallmouth Bass				X	X	X					X	X
Spotfin Shiner				X	X	X						
Steelcolor Shiner					X							
▲ Stonecat				X								
Stoneroller	X	X	X									
Striped Shiner		X										
Warmouth		X	X		X							
● White Sucker	X	X	X	X	X	X	X		X	X	X	X
Yellow Bullhead				X		X						

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Stream	Puterbaugh Creek			Lily Creek		Christiana Creek					Cobus Creek
Site Number	26	27		28		29		30	31		32
		1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass		1st Pass	2nd Pass	
●Black Bullhead						X					
●Blacknose Dace											X
Bluegill	X	X	X	X	X	X	X	X	X	X	X
Bluntnose Minnow						X	X				
●Central Mudminnow	X		X								X
Channel Catfish									X		
Chestnut Lamprey						X	X		X		
●Common Carp						X		X	X	X	
Common Shiner							X				X
●Creek Chub			X	X							X
Golden Redhorse								X	X		
Grass Pickerel	X	X	X	X	X			X		X	
●Green Sunfish		X						X	X		X
▲Hornyhead Chub						X	X		X	X	X
Hybrid Sunfish	X		X							X	
Johnny Darter		X	X								
Largemouth Bass	X		X							X	
Logperch						X	X	X	X	X	
Longear Sunfish									X	X	
Mottled Sculpin			X								
Northern Hog Sucker						X	X	X	X	X	
Orangethroat Darter						X	X			X	
Pirate Perch	X										
Pumpkinseed		X				X					
Rainbow Darter						X	X			X	
Redear Sunfish		X	X								
▲River Chub						X	X				
Rock Bass						X	X	X	X	X	
Sand Shiner							X				
Shorthead Redhorse									X	X	
Silver Redhorse							X	X			
Smallmouth Bass						X	X	X	X	X	
Spotfin Shiner									X	X	
▲Stonecat						X			X	X	
Stoneroller			X								
Striped Shiner						X		X	X	X	
Tadpole Madtom						X	X				
Warmouth		X	X								
●White Sucker		X	X				X	X	X	X	
Yellow Bullhead			X			X	X	X		X	X

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Stream	Elkhart River													
Site Number	33	34	35	36		37	38		39		40		41	42
				1st Pass	2nd Pass		1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass		
▲ American Brook Lamprey				X			X							
Black Crappie			X	X	X	X		X			X			X
Blackside Darter	X	X		X		X	X	X	X	X				
Blackstripe Topminnow			X											
Bluegill	X	X	X		X	X	X	X	X	X	X	X	X	X
● Bluntnose Minnow	X	X	X		X	X	X			X	X		X	
Bowfin			X					X						
● Central Mudminnow		X												
Channel Catfish		X												X
Chestnut Lamprey				X	X	X	X		X	X	X	X	X	X
● Common Carp	X	X	X					X						X
Common Shiner	X	X	X	X	X	X	X	X	X			X		X
● Creek Chub		X		X			X							
● Fathead Minnow				X										
Golden Redhorse	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Grass Pickerel		X	X	X	X	X								
▲ Greater Redhorse					X	X	X				X		X	
● Green Sunfish		X	X	X	X	X	X	X	X	X	X	X	X	X
▲ Hornyhead Chub	X	X		X	X	X	X	X	X	X	X	X	X	
Hybrid Sunfish				X		X	X	X						
Johnny Darter	X	X												
Largemouth Bass		X	X	X	X	X	X	X	X	X	X	X		X
Logperch														X
Longear Sunfish	X	X	X	X			X		X	X	X	X	X	X
▲ Mimic Shiner			X				X							
Northern Hog Sucker	X	X		X	X	X	X	X	X	X	X	X	X	X
Northern Pike	X	X	X											
Orangethroat Darter	X	X												
Pirate Perch		X	X											
Pumpkinseed			X	X	X							X	X	X
Quillback														X
Rainbow Darter	X	X												
Rainbow Trout														X
Redear Sunfish							X	X		X		X	X	
▲ River Redhorse				X			X							X
Rock Bass	X	X	X	X	X	X	X	X	X	X	X	X	X	X
▲ Rosyface Shiner	X		X	X	X		X		X	X	X		X	
Sand Shiner	X			X	X		X				X		X	
Shorthead Redhorse														X
Smallmouth Bass	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Spotfin Shiner	X	X	X	X	X	X	X		X	X	X		X	X
Spotted Sucker		X	X	X		X	X	X			X	X	X	
Steelcolor Shiner					X					X				
▲ Stonecat	X					X								
Striped Shiner		X		X	X	X	X	X	X	X	X	X	X	X
Walleye														X
Warmouth				X										
● White Sucker	X	X	X	X	X	X	X	X	X	X	X	X	X	
Yellow Bullhead						X			X					X

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Stream	Stoney Creek	Solomon Creek		Turkey Creek		Rock Run Creek		Yellow Creek								
Site Number	43	44	45	46	47	48	49	50	51		52		53	54		55
									1st Pass	2nd Pass	1st Pass	2nd Pass		1st Pass	2nd Pass	
●Black Bullhead											X			X		
Black Crappie				X					X	X		X				
●Blacknose Dace	X	X	X				X		X	X	X	X	X	X	X	X
Blackside Darter			X	X	X							X				
Bluegill	X	X	X	X	X	X	X		X	X	X	X			X	X
●Bluntnose Minnow	X					X	X		X	X	X	X	X	X	X	X
Brook Stickleback									X				X			
Brown Trout			X													
●Central Mudminnow	X	X	X	X	X	X			X							
Chestnut Lamprey						X					X		X			X
●Common Carp		X	X		X											
Common Shiner	X			X		X	X		X	X	X	X	X	X	X	X
●Creek Chub	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
●Fathead Minnow	X							X	X	X	X	X		X		X
Golden Redhorse			X	X										X		
Grass Pickerel		X	X	X	X											
●Green Sunfish	X			X	X	X	X		X	X	X	X			X	X
▲Hornyhead Chub				X	X	X	X		X		X	X	X	X	X	X
Johnny Darter	X		X	X	X	X	X			X	X	X	X	X	X	X
Largemouth Bass				X								X			X	X
Longear Sunfish					X											
▲Longnose Dace											X					
▲Mimic Shiner																X
Northern Hog Sucker			X	X	X		X									X
Orangethroat Darter											X	X				
Pirate Perch				X	X							X				
Pumpkinseed				X		X			X	X						X
Rainbow Darter			X		X	X	X					X				
Rainbow Trout			X													
Rock Bass				X	X		X									X
▲Rosyface Shiner																X
Sand Shiner																X
Silverjaw Minnow									X	X	X	X	X	X	X	X
Smallmouth Bass					X		X							X	X	X
Spotfin Shiner										X						
Stoneroller	X	X	X						X	X	X	X	X	X	X	
Striped Shiner	X						X				X					X
●White Sucker	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X
Yellow Bullhead				X	X				X		X					
Yellow Perch											X	X				

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Stream	Baugo Creek		Phillips Ditch	Bowman Creek		Juday Creek											
Site Number	56	57	58	59		60	61		62	63		64	65				
				1st Pass	2nd Pass		1st Pass	2nd Pass		1st Pass	2nd Pass		1st Pass	2nd Pass			
●Blacknose Dace	X	X	COLLECTED	COLLECTED	COLLECTED	X		X	X	X	X	X	X	X			
Bluegill	X	X								X			X				
●Bluntnose Minnow	X	X															
Brown Trout										X	X	X					
●Central Mudminnow	X																
●Common Carp		X															
Common Shiner	X	X															
●Creek Chub	X	X							X	X	X	X	X	X	X	X	X
●Fathead Minnow	X	X															
●Green Sunfish	X	X							X	X	X	X		X	X		
Hybrid Sunfish		X					X										
Johnny Darter	X	X				X		X			X	X		X			
Largemouth Bass								X						X			
Mottled Sculpin						X	X	X	X	X	X	X	X	X			
Orangethroat Darter												X					
Quillback		X															
Rainbow Darter													X	X			
Rainbow Trout										X		X	X	X			
Rock Bass							X	X		X	X						
Sand Shiner		X															
Silver Redhorse		X															
Silverjaw Minnow	X	X															
Smallmouth Bass							X	X				X					
Stoneroller	X	X															
Striped Shiner	X																
●White Sucker		X				X	X	X	X	X	X	X	X	X			
Yellow Bullhead	X																

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ELKHART-SOUTH BEND FISH COMMUNITY MONITORING



**ANNUAL REPORT
2003**

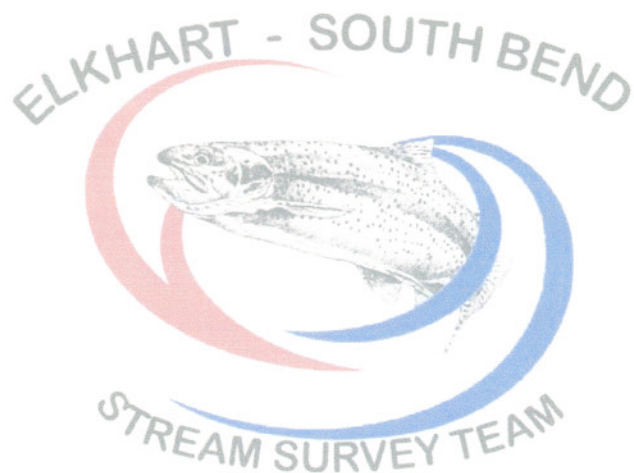
City of Elkhart 
The city with a heart

David L. Miller, Mayor

Cover Photo: Public demonstration at Rhapsody in Green 2003

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FISH COMMUNITY MONITORING IN ELKHART AND ST. JOSEPH COUNTIES ON THE ST. JOSEPH RIVER AND SELECTED TRIBUTARIES, 2003



**Prepared by
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Aquatic Biologist
April, 2004**

INTRODUCTION

The headwaters of the St. Joseph River originate at Baw Beese Lake in Hillsdale County, Michigan. As this river flows from Michigan into Indiana and then back into Michigan on its 210 mile journey to Lake Michigan, it has become a centerpiece for community development and recreation in most of the areas through which it flows. Over the years city and county parks have developed and prospered along its banks. A world-class trout and salmon fishery has evolved and walleye have become more abundant due to the tireless efforts of Michigan and Indiana natural resource professionals. Annual clean-up efforts by a multitude of local organizations along segments of the river are also slowly chipping away at the trash that has built up. After years of neglect, these organizations are working to keep the river an attractive place to visit. During this time, the cities of Elkhart and South Bend have also been monitoring the river's water in an effort to protect the public and the aquatic communities that inhabit this river (Foy 2002).

In 1972, the Clean Water Act was established to restore and maintain the physical, chemical and biological integrity of the nation's waters. At the time, there were acceptable methods to measure the physical and chemical components of water, but methods to measure the health of aquatic communities were not yet standardized. In an attempt to indirectly monitor the biological integrity of rivers and streams until an appropriate method could be designed, water chemistry results were used to determine if the water was safe for aquatic organisms.

For years now, ecologists and biologists have recognized the shortcomings of using chemical monitoring as a surrogate for monitoring the health and condition of aquatic species (Ohio EPA 1988). While chemical monitoring is important and useful in identifying contaminants in the water being tested, its results provide limited information about the biological integrity of the aquatic species that are present. In short, to have an accurate understanding of the true condition of any aquatic community, that community should be directly sampled and analyzed. In 1998, Elkhart initiated a biological monitoring program to supplement its existing chemical and microbial monitoring. The results from this multi-faceted monitoring strategy will finally provide a way for Elkhart to accurately assess the chemical, physical and biological integrity of the rivers and streams in this area as the Clean Water Act had intended.

In the fall of 2000, the City of South Bend expressed an interest in a cooperative fish community study on the St. Joseph River with the City of Elkhart. South Bend had observed how the 1998-2000 fish community information was being put to use by Elkhart and determined that similar information from their area would be helpful. Likewise, Elkhart felt additional biological information from the St. Joseph River would prove useful on future projects dealing with the river's watershed. Biologists know rivers and streams are not confined to one political boundary or area, but flow across several. Even with this knowledge, governmental agencies tend to study and monitor these rivers and streams within the confines of those established boundaries. In February of 2001, an interlocal agreement was signed between Elkhart and South Bend that erased one political boundary and finally allowed these municipalities a glimpse at the health of the fish communities throughout the entire stretch of the St. Joseph River as it flows through Indiana.

The biological monitoring strategy developed by Elkhart has established core stations on the St. Joseph River and its major tributaries in Elkhart and St. Joseph counties. Results obtained from 1998-2003 at these stations will be used to create a baseline of information for all of the streams sampled. To date, this baseline information has been used to reveal what impact Elkhart's urban environment has on the receiving streams and will be used to document any changes in the fish communities over time.

The Index of Biotic Integrity (IBI), as modified by Simon (1997) for use in the St. Joseph River basin, will be utilized to assess the fish community information. This index was developed by Karr (1981), and is most useful in translating complex fish community information into a more understandable format for non-biologists. In simplest terms, the IBI acts as a biological indicator much like the DOW Industrial Average acts as an economic indicator (Karr 1996) and it provides a method to track the trends in fish community condition over time. It is comprised of three broad categories (species composition, trophic composition, and fish condition) which are broken down into 12 smaller categories known as metrics (Appendix A) to assess fish communities. These metrics are each given a score based on their similarity to least impacted (reference) sites; 1 (not similar), 3 (somewhat similar), or 5 (very similar). The total score for a site will range from 12 to 60 (a score of zero indicates no fish were collected). These scores can then be graphed and placed into one of five classifications (very poor, poor, fair, good, or excellent) which describes the overall condition of the fish community being sampled.

Biologists recognize that fish community condition is a product of the water quality *and* the habitat that is available in any given area. In 2003, available habitat at all sampling locations was assessed using the Qualitative Habitat Evaluation Index (QHEI) (Rankin 1989). This index is similar to the IBI in its structure. It has six broad categories which are broken down into 21 smaller categories or metrics (Appendix A). This index will have a final score of 0 to 100 and the scores will be classified as excellent, good, fair-good, poor, and very poor. This assessment will help determine to what extent the IBI scores are being affected by habitat and to begin cataloging the quality of available habitat in all the local rivers and streams.

In addition to monitoring the water quality in the St. Joseph River and some of its tributaries, sampling was also conducted to determine the overall diversity of the fish species in the Elkhart and South Bend areas. Elkhart's aquatics staff continued tagging smallmouth bass (*Micropterus dolomieu*), largemouth bass (*Micropterus salmoides*) and walleye (*Stizostedion vitreum*) collected throughout the year. This tagging effort will assist the Indiana Department of Natural Resources (IDNR) in determining the movement patterns of walleye and alert anglers to Elkhart and South Bend's monitoring activities. Scale samples were also taken from all walleye, smallmouth and largemouth bass over 75 mm in length for age and growth analysis. This information will be released in a report later this year. Finally, tissue from eleven species of fish was sampled and analyzed for mercury and PCB (polychlorinated biphenyl) content. This information was added to Elkhart and South Bend's existing tissue data from the St. Joseph and Elkhart Rivers and Juday Creek. At present, several species are on the Indiana Fish Consumption Advisory (FCA) (Table 1) for these streams and the cities want to contribute additional information to the state's fish tissue database so the most accurate and thorough advisory possible may be issued.

Table 1: Fish consumption information taken from the 2003 Indiana Fish Consumption Advisory

Location	Species	Fish Size (inches)	Contaminant	Group
Elkhart River Elkhart County	Rock Bass	7-9	■	2
		9+	■	3
	Smallmouth Bass	11-17	■O	2
		17+	■O	3
	White Sucker	14-16	■O	2
		16+	■O	3
St. Joseph River Elkhart County	Black Redhorse	13-17	O	2
		17+	O	3
	Carp	25-28	■	3
		28+	■	4
	Channel Catfish	16-29	■	2
		29+	■	3
	Golden Redhorse	15-17	■	2
		17+	■	3
	Largemouth Bass	13-14	O	2
		14+	O	3
	Northern Hogsucker	13-15	■	2
		15+	■	3
	Rock Bass	7+	O	2
	Shorthead Redhorse Redhorse	15-17	■	3
		17+	■	4
	Smallmouth Bass	10-11	■	2
		11+	■	3
	Walleye	15-16	■O	2
		16+	■O	3
St. Joseph River St. Joseph County	Black Redhorse	16-18	■	3
		18+	■	4
	Carp	20+	■	5
	Channel Catfish	22+	■O	4
	Golden Redhorse	13-22	■	3
		22+	■	4
	Largemouth Bass	11-14	■	2
		14+	■	3
	Quillback	18+	■	3
	Rock Bass	7-8	■	2
		8+	■	3
	Shorthead Redhorse	15-19	■O	3
		19+	■O	4
	Smallmouth Bass	7-9	■O	2
		9+	■O	3
	Steelhead	25-26	■	3
		26+	■	4
	White Sucker	14-16	■	3
		16+	■	4
Juday Creek	White Sucker	12-17	■	2
		17+	■	3

O = Mercury

■ = PCBs

Group 2 = 1 meal/week

Group 3 = 1 meal/month

Group 4 = 1 meal/2 months

Group 5 = DO NOT EAT

(Special restrictions apply to women and children. See advisory.)

METHODS

To quickly identify the majority of fish species present and to determine water quality levels in the St. Joseph River and its tributaries, two sampling approaches were utilized. Investigative sites were sampled only once and all fish collected at these sites were identified to species, the largest and smallest of each species were measured to the nearest millimeter (mm), the fish were counted, and then released. Index sites, on the other hand, were sampled twice during the summer with a five-week interval between samples, and the length of the sample area was dependent on the stream's width. The length of these sites was 15 times the stream's width with a minimum length of 50 meters and a maximum length of 500 meters. Fish collected at index sites were studied more extensively. These fish were also identified to species and then processed in one of two ways. First, game fish (smallmouth bass, rock bass, bluegill, etc.) were measured by length to the nearest millimeter, individually weighed to the nearest gram (g), and then released. Non-game

fish (suckers, darters, minnows, etc.) were counted, the largest and smallest of each species were measured to the nearest millimeter, species were mass weighed to the nearest gram, and then released. This index/investigative sampling strategy allows for the maximum number of streams and sites to be sampled in the limited amount of time available during the summer. Investigative sites were generally sampled for a shorter distance (less than 15 times the stream width) and game fish other than bass and walleye that were individually measured at index sites were not weighed or individually measured at these sites. These differences in sampling and processing allowed for multiple investigative sites to be sampled in a day versus one to two index sites. Additionally, if a specimen of a species had not been previously retained from a site for the Public Works & Utilities specimen museum, then a single specimen of the smaller species was retained and larger specimens were photographed. This practice allows for the verification of the field and lab identifications if needed.

Figure 1: Fish sampling sites in Elkhart and St. Joseph Counties and associated fish community condition for 2003

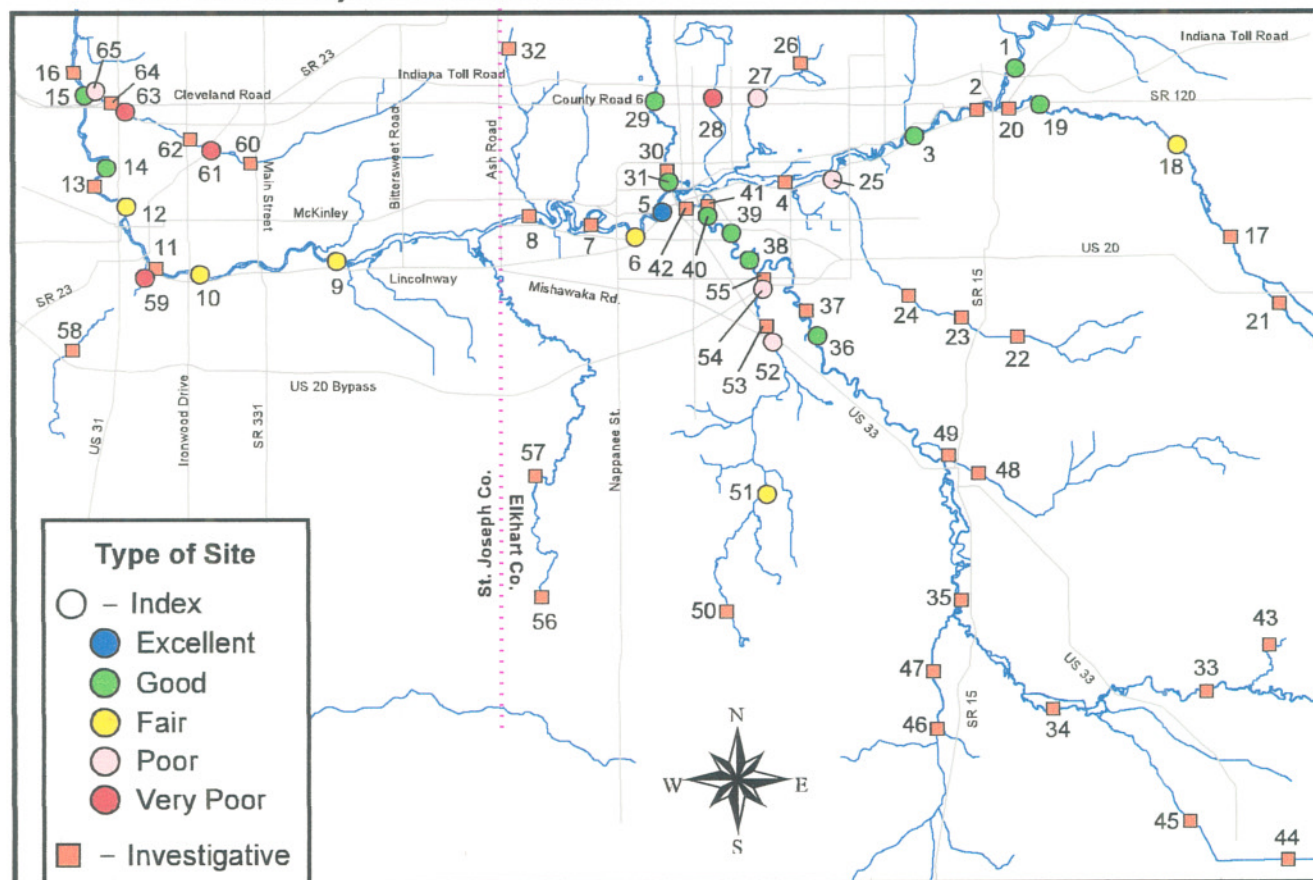


Table 2: Fish sampling sites in Elkhart and St. Joseph Counties, 2003

Site Number	Site Description	Type of Site (Index/Investigative) County	Method	IBI Scores				2003 QHEI Score
				2001	2002	2003	Average	
1	Toll Road (Bristol) St. Joseph River	Index Elkhart	Boat	47	50	54	50	74
2	Bristol (B) St. Joseph River	Investigative Elkhart	Boat					NOT ASSESSED
3	Nibbyville (A) St. Joseph River	Index Elkhart	Boat	51	54	52	52	71
4	County Road 13 St. Joseph River	Investigative Elkhart	Boat					52
5	Lexington Avenue St. Joseph River	Index Elkhart	Boat	51	50	55	52	64
6	McNaughton Park St. Joseph River	Index Elkhart	Boat	44	51	44	46	61
7	Treasure Island County Park St. Joseph River	Investigative Elkhart	Boat					NOT ASSESSED
8	Mouth of Cobus Creek St. Joseph River	Investigative Elkhart	Boat					56
9	Capital Avenue St. Joseph River	Index St. Joseph	Boat	43	45	42	43	63
10	Ironwood Drive St. Joseph River	Index St. Joseph	Boat	45	41	43	43	66
11	Sample Street St. Joseph River	Investigative St. Joseph	Boat					NOT ASSESSED
12	Michigan Street St. Joseph River	Index St. Joseph	Boat	44	50	41	45	80
13	Angela Boulevard St. Joseph River	Investigative St. Joseph	Boat					78
14	Keller Park St. Joseph River	Index St. Joseph	Boat	51	50	49	50	75
15	Darden Road St. Joseph River	Index St. Joseph	Boat	50	51	48	50	77
16	Brick Road St. Joseph River	Investigative St. Joseph	Boat					76
17*	County Road 16 Little Elkhart River	Investigative Elkhart	Tote Barge					72
18*	County Road 35 Little Elkhart River	Index Elkhart	Tote Barge		44	40		88
19*	State Road 120 Little Elkhart River	Index Elkhart	Tote Barge		52	53		77
20*	State Road 15 Little Elkhart River	Investigative Elkhart	Tote Barge					68
21	County Road 43 Rowe-Eden Ditch	Investigative Elkhart	Tote Barge					67
22*	County Road 27 Pine Creek	Investigative Elkhart	Back Pack					40
23*	County Road 20 Pine Creek	Investigative Elkhart	Back Pack					60
24*	County Road 19 Pine Creek	Investigative Elkhart	Tote Barge					60
25*	SR 120 Pine Creek	Index Elkhart	Tote Barge	38	48	35	40	71
26*	County Road 4 Puterbaugh Creek	Investigative Elkhart	Back Pack					27
27*	Reedy Drive Puterbaugh Creek	Index Elkhart	Tote Barge	33	41	36	37	63

Table 2 (continued)

Site Number	Site Description	Type of Site (Index/Investigative) County	Method	IBI Scores				2003 QHEI Score
				2001	2002	2003	Average	
28	Park Six Drive Lily Creek	Index Elkhart	Back Pack		15	16		37
29	County Road 6 Christiana Creek	Index Elkhart	Tote Barge	47	51	53	50	74
30	Simonton Street Christiana Creek	Investigative Elkhart	Tote Barge					70
31	N. Main Well Field Christiana Creek	Index Elkhart	Tote Barge	44	47	52	48	79
32*	Cross Creek Drive Cobus Creek	Investigative Elkhart	Tote Barge					57
33	County Road 37 Elkhart River	Investigative Elkhart	Tote Barge					75
34	County Road 127 Elkhart River	Investigative Elkhart	Tote Barge					84
35	County Road 40 Elkhart River	Investigative Elkhart	Boat					62
36	Oxbow Park (B) Elkhart River	Index Elkhart	Boat	51	52	54	52	82
37	Ironwood Drive Elkhart River	Investigative Elkhart	Boat					87
38	Elkhart Environmental Center Elkhart River	Index Elkhart	Boat	51	52	50	51	79
39	Studebaker Park (A) Elkhart River	Index Elkhart	Boat	46	46	46	46	78
40	Central High School Elkhart River	Index Elkhart	Boat	44	43	47	45	70
41	Rice Field Elkhart River	Investigative Elkhart	Boat					62
42	Elkhart Avenue Elkhart River	Investigative Elkhart	Boat					81
43	County Road 42 Stoney Creek	Investigative Elkhart	Tote Barge					60
44*	County Road 43 Solomon Creek	Investigative Elkhart	Tote Barge					36
45*	County Road 52 Solomon Creek	Investigative Elkhart	Tote Barge					60
46	County Road 146 Turkey Creek	Investigative Elkhart	Tote Barge					53
47	County Road 142 Turkey Creek	Investigative Elkhart	Tote Barge					55
48	State Road 4 Rock Run Creek	Investigative Elkhart	Tote Barge					48
49	1st Street Rock Run Creek	Investigative Elkhart	Tote Barge					58
50	County Road 40 Yellow Creek	Investigative Elkhart	Back Pack					24
51	County Road 32 Yellow Creek	Index Elkhart	Tote Barge	36	37	37	37	52
52	Concord High School Yellow Creek	Index Elkhart	Tote Barge	32	36	35	34	59
53	Concord Mall Yellow Creek	Investigative Elkhart	Tote Barge					39
54	US 20 Bypass Yellow Creek	Index Elkhart	Tote Barge	28	38	31	32	50
55	Hively Avenue Yellow Creek	Investigative Elkhart	Tote Barge					54

Table 2 (continued)

Site Number	Site Description	Type of Site (Index/Investigative) County	Method	IBI Scores				2003 QHEI Score
				2001	2002	2003	Average	
56	County Road 1 (Wakarusa) Baugo Creek	Investigative Elkhart	Tote Barge					40
57	County Road 130 Baugo Creek	Investigative Elkhart	Tote Barge					62
58	Gertrude Phillips Ditch	Investigative St. Joseph	Back Pack					49
59	Ravina Park Bowman Creek	Index St. Joseph	Back Pack	12	6	0	6	34
60*	Grape Road Juday Creek	Investigative St. Joseph	Tote Barge					57
61*	State Road 23 Juday Creek	Index St. Joseph	Tote Barge	23	34	20	26	60
62*	Ironwood Road Juday Creek	Investigative St. Joseph	Back Pack					49
63*	Myrtle Street Juday Creek	Index St. Joseph	Tote Barge	19	23	21	21	52
64*	Kenilworth Road Juday Creek	Investigative St. Joseph	Back Pack					66
65*	Izaak Walton League Juday Creek	Index St. Joseph	Tote Barge		26	27		75

* denotes a cool/cold water site

In 2003, 18 index and 31 investigative sites were sampled in Elkhart County and 9 index and 7 investigative sites were sampled in St. Joseph County (Figure 1 and Table 2). Index sites were sampled twice with at least a five week "rest" period between visits, and investigative sites were generally sampled only once. IBI scores were calculated for every index site visit, then the scores for the two visits at each site were averaged to calculate the annual score.

All sites were sampled utilizing either backpack, tote barge, or boat mounted electrofishing gear. The type of equipment used depended on the depth of the stream. For the smallest streams that would not accommodate the tote barge equipment, the battery powered backpack unit was used. If the stream was larger and wadeable for at least 80-90% of the area to be sampled, the tote barge equipment was used. All other areas were sampled utilizing the boat equipment. Power output of the three types of equipment varied. The backpack output was 0.5-1.5 amperes, the tote barge was 4-6 amperes, and the boat was 8-16 amperes.

Beginning in 2003, stream habitat information was systematically collected from both index and investigative sites using the Qualitative Habitat Evaluation Index (QHEI) as developed by Ohio

EPA (Rankin 1989). In 1999 and 2002, Elkhart attempted to collect this information, but due to inconsistencies in data collection, the information was never reported. In 2003, however, multiple field personnel assessed the habitat at each fish sampling site after the fish were processed and released. These multiple assessments were then averaged for each site (Table 2).

Smallmouth bass greater than 10 inches, walleye greater than 12 inches and largemouth bass greater than 14 inches in length also had an anchor tag applied under the left anterior edge of the dorsal fin (Figure 2). This tag contained Elk-

Figure 2: Location of tag on fish

Table 3: Fish tissue sites

Site Number	Stream	Station
1	St. Joseph River	Toll Road (Bristol)
2	St. Joseph River	Bristol
3	St. Joseph River	Middleton Run Road (CR 13)
4	St. Joseph River	Lexington Avenue
5	St. Joseph River	McNaughton Park
6	St. Joseph River	Nappanee Street
7	St. Joseph River	Ironwood Drive
8	St. Joseph River	Michigan Street
9	St. Joseph River	Keller Park
10	St. Joseph River	Darden Road
11	St. Joseph River	Brick Road
12	Elkhart River	Oxbow Park (B)
13	Elkhart River	EEC (A)
14	Juday Creek	State Road 23

hart Public Works & Utilities' phone number and a unique tag number. The biggest advantage of this tagging study is its ability to reveal important movement patterns of these fish and help the IDNR in its walleye stocking efforts on the St. Joseph River.

Tissue in the form of fillets was collected from common carp (*Cyprinus carpio*), smallmouth bass,

largemouth bass, rock bass (*Ambloplites rupestris*), walleye, steelhead (*Oncorhynchus mykiss*), channel catfish (*Ictalurus punctatus*), golden redbreast (*Moxostoma erythrurum*), black redbreast (*M. duquesnei*), shorthead redbreast (*M. macrolepidotum*), quillback (*Carpionodes cyprinus*), and white sucker (*Catostomus commersoni*) from July through August. The tissue samples were collected from two sites on the Elkhart River, one site on Juday Creek, and eleven sites on the St. Joseph River (Table 3 & Figure 3). Each tissue sample sent in for analysis was a composite of tissue from three fish of the same species at the given site or area. The samples were collected following the procedures in Appendix B (this report) and Appendix III in "Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory" (1993).

RESULTS & DISCUSSION

During the summer of 2003 a total of 24,170 fish were collected in Elkhart County and 6,347 fish were collected in St. Joseph County (Appendix C). In Elkhart County these fish represented 68 species in 17 families of fish and in St. Joseph County, the fish collected represented 51 species from 13 families. In all, 70 species were collected from the two counties. Smallmouth bass, creek chub (*Semotilus atromaculatus*), and longear sunfish (*Lepomis megalotis*) were the top three species collected in St. Joseph County, while white sucker, creek chub, and mimic shiner (*Notropis volucellus*) were the top three species found in Elkhart County.

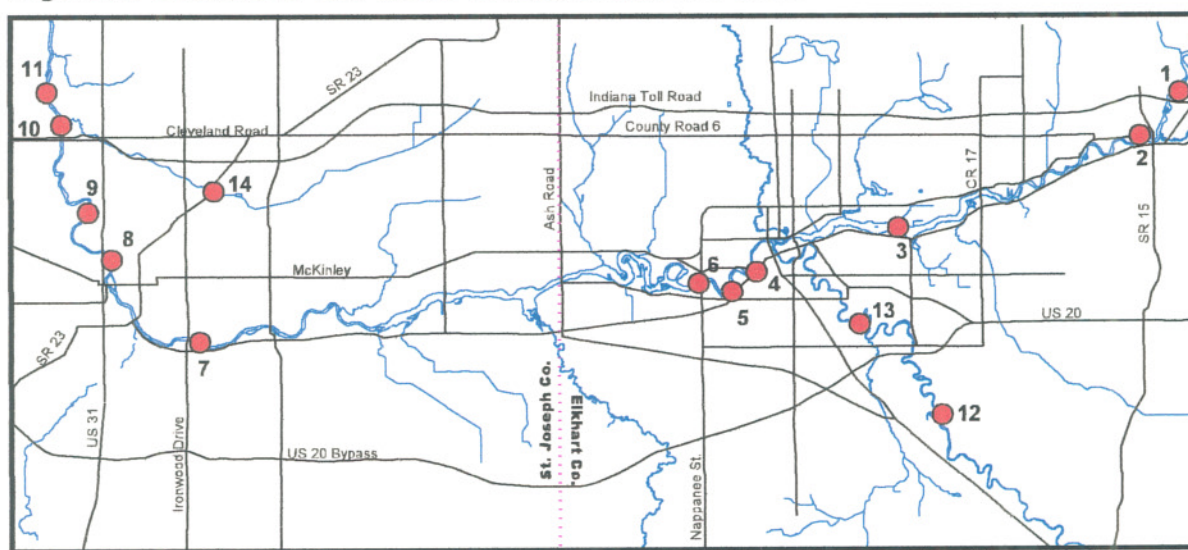
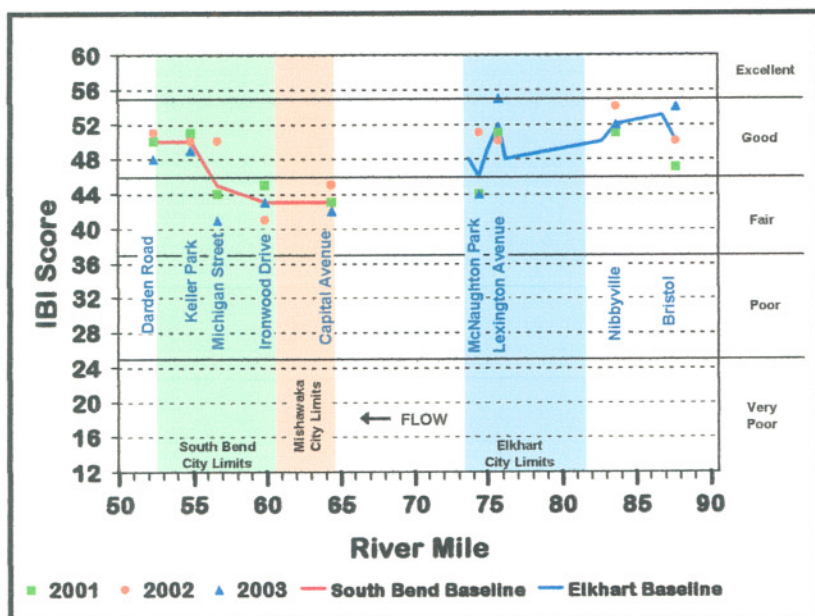
Figure 3: Location of fish tissue collection sites for 2003

Figure 4: IBI scores for the St. Joseph River, Elkhart and St. Joseph Counties



Joseph River. Typically, IBI scores will fall between 12 and 60. However, if no fish are collected during a visit to one of the sites, then the site will score 0 (zero) for that visit. In the case of Ravina Park on Bowman Creek, no fish were collected during either site visit, resulting in an IBI score of zero for the site in 2003. The habitat quality at the index and investigative sites ranged from very poor (24) at County Road 40 on Yellow Creek to excellent (88) at County Road 35 on the Little Elkhart River. As a point of reference, biologists generally consider sites on rivers and streams to be achieving their full potential when habitat quality and fish community condition at study sites fall in the good to excellent classifications in their respective index.

INDICES

In the past, there were several issues to keep in mind while looking at the IBI information. The first issue, determining whether calculated IBI scores were being affected by both water quality and/or available habitat, has been clarified due to the habitat assessments (QHEI) that were performed at almost all sites in 2003. The second issue, the use of the calibrated IBI with sites on the St. Joseph River that have drainage areas over 1,000 square miles, has been determined by T. Simon (personal communication) to not be a concern. The third issue, no IBI scoring of sites in impounded areas, will still hold true because the IBI metrics used for calculating the scores were developed for flowing waters. The fish communities found in impounded areas (more bass and sunfish, fewer suckers and redhorse) are more similar to what would be found in a lake than in a naturally flowing river.

The IBI and QHEI scores for 2003 are summarized in Table 2. The condition of the fish communities at the index sites ranged from very poor (0) at Ravina Park on Bowman Creek to excellent (55), at Lexington Avenue on the St.

The longitudinal trends in fish community condition for the entire St. Joseph River in Indiana can be seen in Figure 4. In the Elkhart area, the 2001-2003 data was added to the information that was collected from 1998-2000 to help establish a more comprehensive baseline. The Elkhart Baseline reveals a classic example of IBI trends as a river flows through an urban environment. The scores are higher at sites upstream of the urban area and begin to fall as the river flows through the populated zone.

Figure 5: QHEI scores for the St. Joseph River, Elkhart and St. Joseph Counties

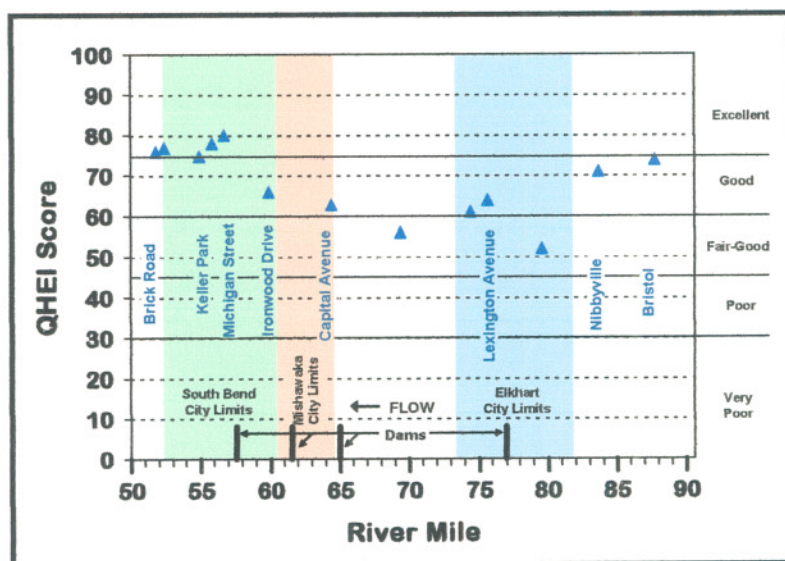
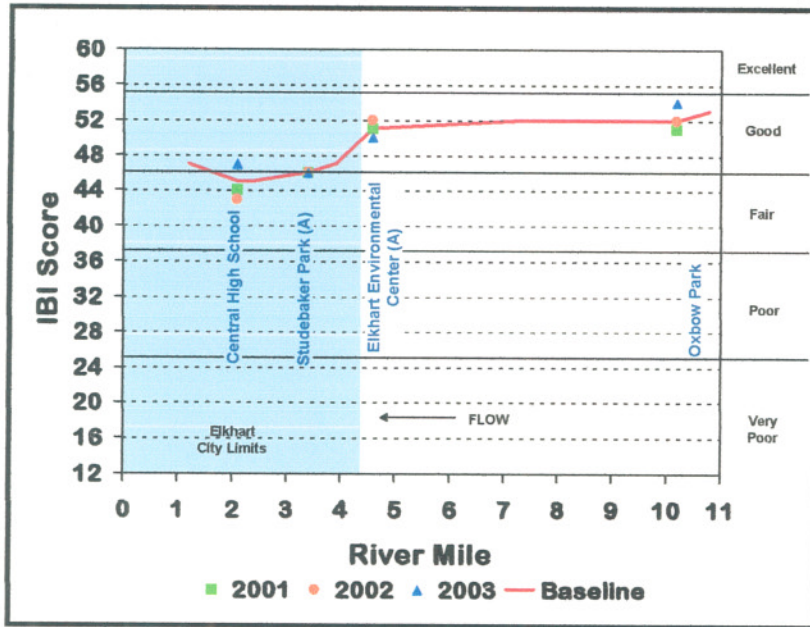


Figure 6: IBI scores for the Elkhart River, Elkhart County



Many urban impacts (i.e. bridges, street run-off, combined sewer overflows, seawalls, lawn fertilizers, etc.) could be affecting this trend, but Figure 5 reveals that decreasing habitat quality may be the major driving force. While the Lexington Avenue site shows a temporary increase in fish community condition, the IBI scores follow the downward trend of the QHEI scores as the river flows through Elkhart. The largest decrease in the QHEI scores in the Elkhart area of the St. Joseph River occur immediately upstream of the hydroelectric dam. This lake-type environment has highly developed shorelines (sheet-driven or concrete seawalls) and little or no diversity in the type of habitat that is favored by stream-dwelling fish.

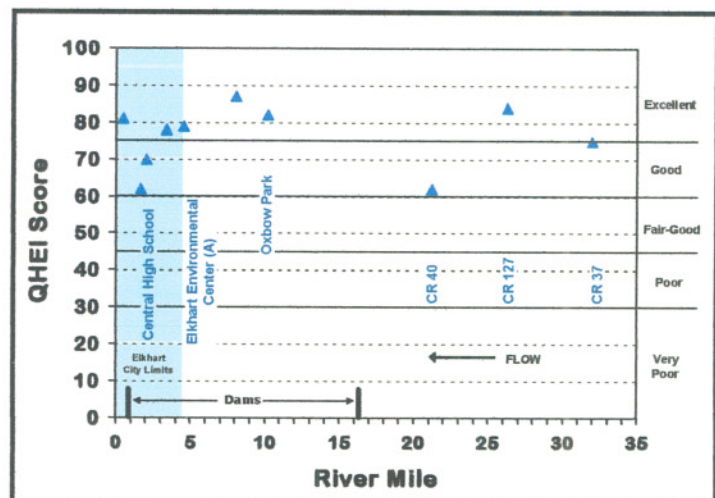
The 2001-2003 South Bend area data for the St. Joseph River was averaged to form a baseline for future comparisons (Figure 4). This initial baseline on the St. Joseph River shows a trend in IBI scores just the opposite of what was seen in Elkhart. This reversal of scores could be due to a number of factors. First, many of the urban impacts previously mentioned are already affecting the river before it reaches the Capital Avenue site due to the number of residences and suburban neighborhoods located adjacent to the river between Elkhart and Mishawaka. Second, shoreline development (houses and/or seawalls)

tends to decrease as the river flows through and out of South Bend, while this same development is lower upstream of Elkhart and increases as the river flows through the city. Interestingly, the IBI scores tend to follow the QHEI scores (Figures 4 & 5) throughout the St. Joseph River in Indiana indicating a strong correlation between habitat and fish community condition.

The IBI scores for the Elkhart River (Figure 6) continue to reflect Elkhart's urban impact, and QHEI scores for this river are generally consistent and in the excellent classification (Figure 7). Some QHEI scoring decreases coincide with site proximity to dams. Since habitat does not appear to be limiting the fish communities in the Elkhart city limits portion of the Elkhart River, the other urban impacts (bridges, street run-off, combined sewer overflows, lawn fertilizers, etc.) must be the driving force of the fish community condition. Better land stewardship activities in the upstream areas of this river's watershed would also contribute to improvements in biological health throughout the river.

Multiple index sites have been sampled on eight of the area tributaries since 1998. Longitudinal views of IBI scores at these sites will compare the results from baseline stations (3 years of data) to the recently sampled (2001-2003) sites.

Figure 7: QHEI scores for the Elkhart River, Elkhart County



Juday Creek and Bowman Creek (Phillips Ditch is an extension of this stream) in St. Joseph County are very different from one another. Juday Creek is a cool/cold water stream that supports trout, while Bowman Creek is much warmer and heavily impacted by the urban environment it flows through. Both drain agricultural and urban lands. The IBI scores on these creeks (Figure 8) also closely follow the same trend as the QHEI scores (Figure 9). In Juday Creek, as the habitat quality increased in the area of the Izaak Walton League, so did the fish community condition (IBI). Likewise, on Bowman Creek as the habitat quality decreased, so did the IBI. Juday Creek's water temperature plays a big role in its fish community condition falling below its potential because the IBI modification used to assess these sites was developed for warmwater streams. Cool/cold water streams tend to have fewer fish and not as many species as warmwater streams and thus generally score lower when assessed with a warmwater IBI. Cool/cold water IBI's have been established for other areas, but are not appropriate for this region. For now, the currently used IBI modification will be used to document any drastic changes over time. Once an acceptable cool/cold water IBI is developed or located, the data collected from Juday Creek will be used to recalculate a more accurate IBI score.

Figure 8: IBI scores for Bowman Creek and Juday Creek, St. Joseph County

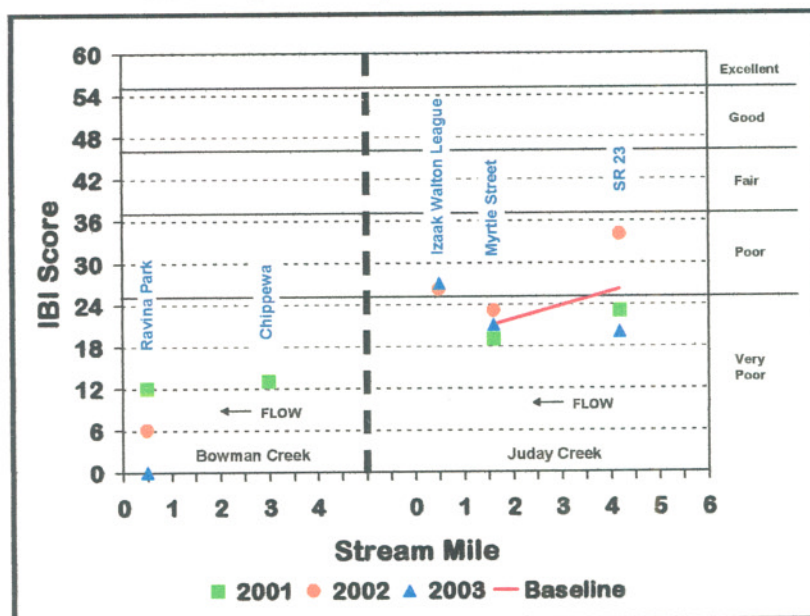
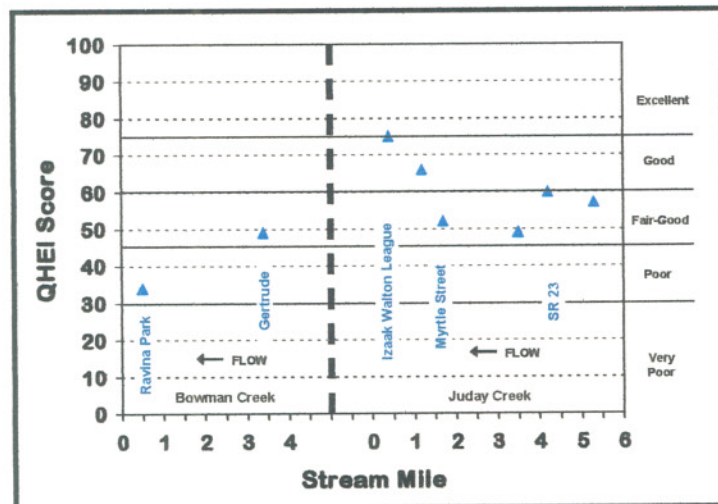


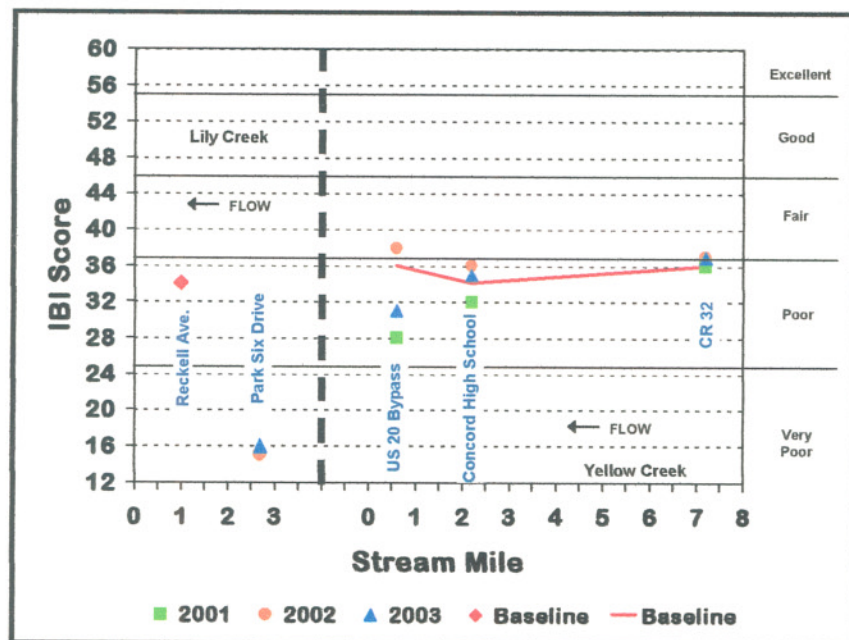
Figure 9: QHEI scores for Bowman Creek and Juday Creek, St. Joseph County



Bowman Creek is smaller than Juday Creek and has been buried in concrete pipes or tunnels for much of its length within the city limits of South Bend. This serious habitat modification is reflected in the QHEI scores (Figure 9) and greatly limits the fish species found in areas like Ravina Park where the stream is above ground. It was also discovered in 2002 and observed again in 2003 that the Ravina Park area of the stream periodically dries out (no flowing water). This, too, limits the number and types of fish found in this area regardless of the habitat quality. The Chippewa site, however, is upstream of the buried sections in a wooded area and also had a very low IBI score in 2001. Historical and current disturbances may have eliminated many of the fish from this area of the stream and recolonization would be very limited to nonexistent from a downstream direction due to the urban modifications just described. Due to difficulties in gaining access to the Chippewa site, it was not sampled in 2002 or 2003 but attempts will be made to sample this site again in 2004.

Lily Creek is a regulated drain that was last dredged in 1997. This dredging activity was done in an effort to decrease flooding impacts to neighboring landowners. The fish community condition at sites located on Lily Creek has been found to be poor to

Figure 10: IBI scores for Lily Creek and Yellow Creek, Elkhart County



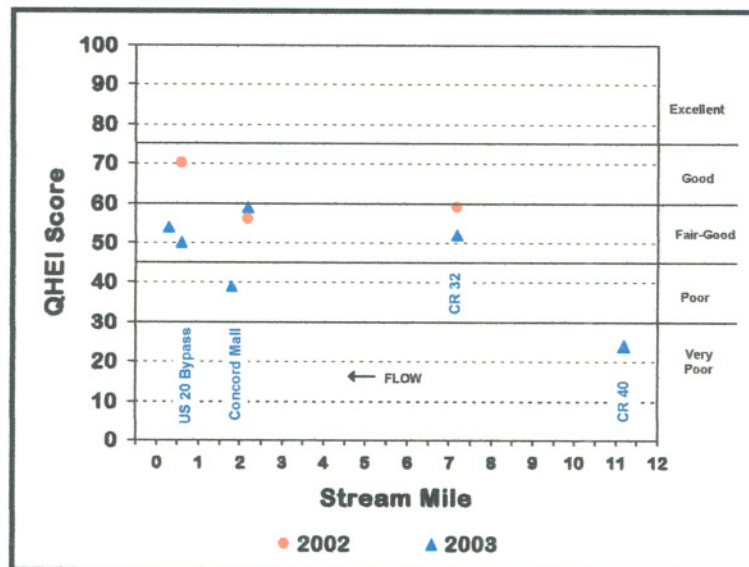
very poor (Figure 10) and available habitat is also very limited (Table 2). Streams of this type may never support a biologically diverse fish community, but that is to be expected due to the main function (agricultural drainage) of the stream. The Park Six Drive site on this stream is very uniform in depth (<12 inches) due to the recent dredging activities and is located in an area of the stream that periodically dries out (personal observation, 2002 and 2003). The Reckell Avenue site, on the other hand, is also modified, but is located in a groundwater recharge zone and still contains one moderately deep (about 2½ feet) pool that may provide temporary refuge for the local fish community when water levels are low. These factors appear to be the driving force behind the variation in IBI scores between these two sites.

In 2000, sampling in Yellow Creek revealed an impact had occurred at the US 20 Bypass site (Foy 2001). Water samples collected from the immediate area as well as from bridges upstream revealed nothing unusual. From 2001 to 2003, an additional index site (Concord High School) was sampled in addition to the existing index sites (County Road 32

and US 20 Bypass) in an attempt to locate the source of this impact. No source was ever found, and, unfortunately, in the winter of 2002 the US 20 Bypass site was severely impacted again due to channel maintenance. While the County Road 32 and Concord High School sites had been regularly dredged in the past and had little or no buffer zone (unmowed grass or uncut forest) along their banks, the US 20 Bypass site had been untouched and had a lot of natural meanders (bends) and a wooded buffer zone. The habitat destruction in the US 20 Bypass area was documented by drastically reduced QHEI scores (Figure 11) for the site from 2002 to 2003. This decrease in available habitat in turn lead to a decrease in the

fish community condition (Figure 10). While the current impact to stream habitat did not affect the fish community to the same extent as the water quality impact did in 2000, the IBI scores will be much slower to recover. This slower recovery is due in part to the nature and extent of the two impacts. The water quality impact was short lived, and as the stream continued to flow, the

Figure 11: QHEI scores for Yellow Creek, Elkhart County

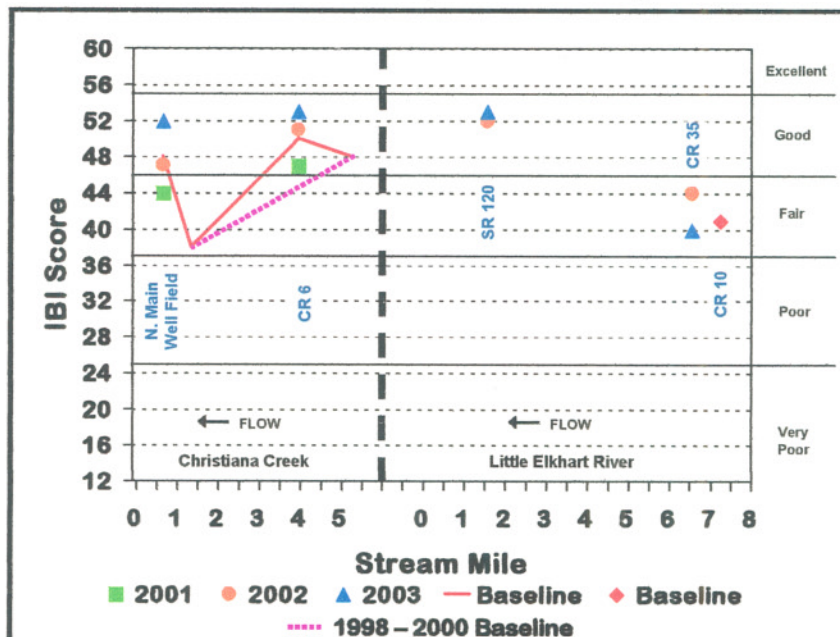


fish community began to recover. The recovery period for the lost habitat, however, will be much longer due to the many years it will take nature to replace this critical component of the stream.

The initial IBI baseline (1998-2000, Figure 12) for Christiana Creek appeared to show the effect our urban environment was having on this stream. However, upon the addition of the 2001-2003 IBI scores to this baseline and habitat information for these new sites (Figure 13), it has become clear that a potential problem area has been identified between County Road 6 and the North Main Well Field sites. In 2004, we will be assessing the habitat and various water quality parameters and reassessing the fish community in this area. This additional information should assist us in identifying what is causing this decline in the fish community in Christiana Creek.

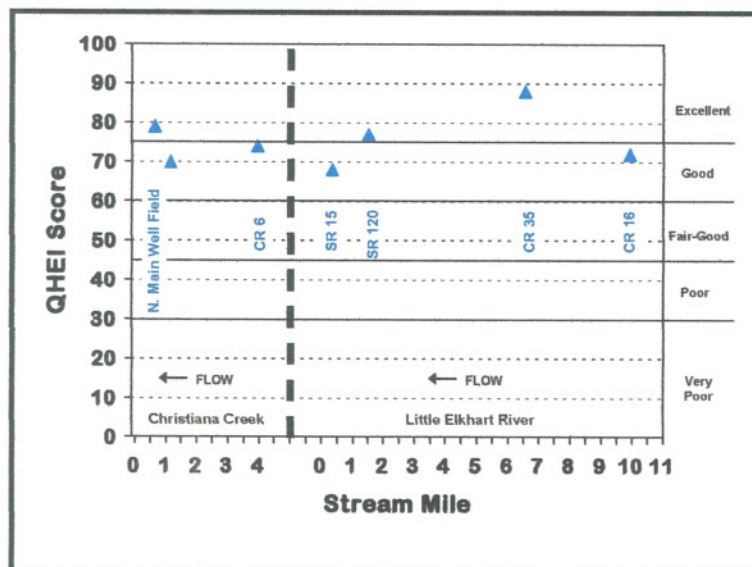
The Little Elkhart River, Puterbaugh Creek, and Pine Creek are cool/cold water streams like Juday Creek and, therefore, have the same limitation in scoring using the warmwater IBI that was devel-

Figure 12: IBI scores for Christiana Creek and the Little Elkhart River, Elkhart County



oped for this area. As explained earlier, the current IBI scoring system will be used to document any drastic changes in these streams until an acceptable cool/cold water IBI is located or developed. At that time the data collected from these streams will be used to recalculate a more accurate score.

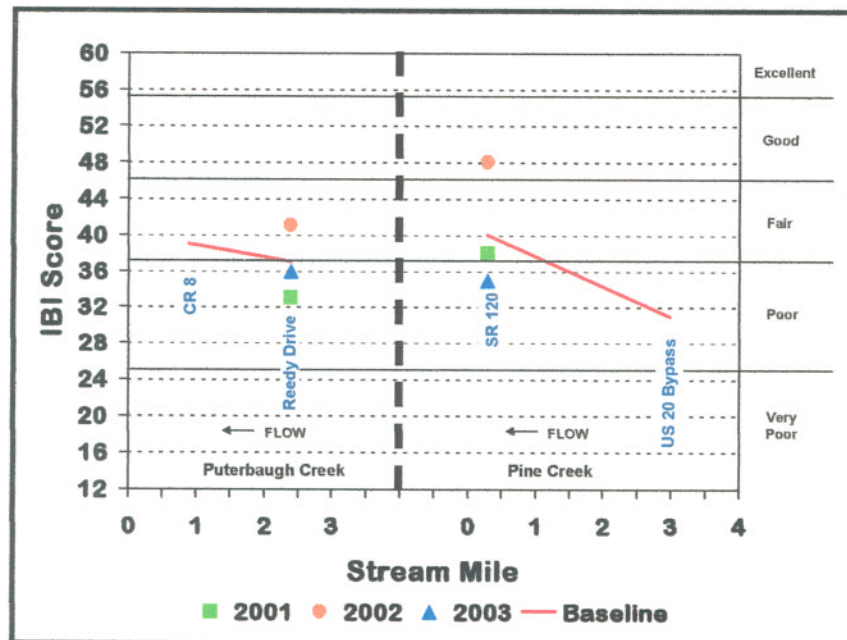
Figure 13: QHEI scores for Christiana Creek and the Little Elkhart River, Elkhart County



While being a coldwater stream with scoring limitations, the Little Elkhart River IBI scores have still fallen in the fair to good range (Figure 12). The increase in IBI scores from the upstream sites to the State Road 120 site does not appear to be affected by the available habitat (Figure 13), but could be due to the proximity of this site to the St. Joseph River. The lower portion of small tributaries often acts as a refuge for some fish from the larger river that they flow into. In areas like this, a mix of stream and river fish may artificially increase the IBI score due to an increase in the number and types of species present. When a properly modified IBI for cool/cold water streams is located, the true quality of the fish community in this stream will be realized.

Puterbaugh Creek flows from a lake but maintains fairly cold water temperatures,

Figure 14: IBI scores for Puterbaugh Creek and Pine Creek, Elkhart County



especially in the lower, or downstream, segments. Groundwater inflow through numerous seeps and springs, especially near the County Road 8 crossing, cause this shift in water temperatures (personal observation). The small size of this stream and the changing water temperature limit the types of fish that will be present. With these limitations in mind, the fish community condition in this stream is fair and basically stable from site to site (Figure 14).

The dramatic increase in IBI scores on Pine Creek (Figure 14) may be partly due to the proximity of the downstream site (State Road 120) to the river and the habitat that is available. This tributary site may act as a refuge, like the State Road 120 site on the Little Elkhart River. A mix of warmwater river species with the usual cool/cold water stream species could increase the IBI score for the site. The US 20 Bypass site also had poor habitat qualities (strongly eroded banks and fairly homogeneous substrate, personal observation) while the State Road 120 site had better available habitat (stable banks, good canopy cover, and a variety of substrates, Figure 15) which would support a more diverse fish community.

TAGGING & MOVEMENT

A total of 656 fish were tagged (Table 4) in 2003 and 87 recapture events were recorded. Since 1998, a total of 312 fish have been recaptured in 337 events. Thanks to the many anglers who have reported catching tagged fish (Table 4), an 11.0% recapture rate has been achieved. This is very acceptable and is up slightly from 2002 (Foy 2003). The number of smallmouth bass and walleye that were recaptured also increased from 2002.

In the spring of 2002 and 2003, Elkhart Public Works' aquatics staff assisted the Indiana Department of Natural Resources (IDNR) with walleye

sampling below the Johnson Street Dam and in the Island Park area of the St. Joseph River. This sampling was done in an effort to get age and growth information from a large number of adult walleye in a short period of time. Due to their annual spawning migration, many adult walleye congregate in this area and were easily collected. While collecting scales from these fish, tags were placed in the larger individuals and this lead to

Figure 15: QHEI scores for Puterbaugh Creek and Pine Creek, Elkhart County

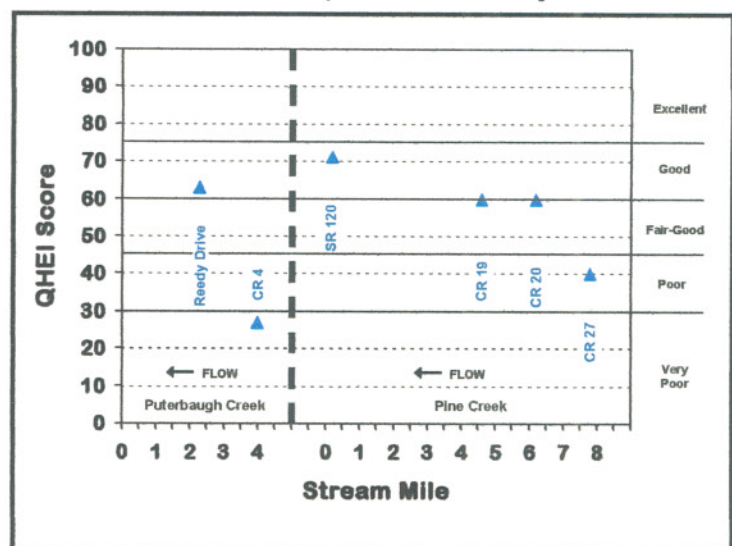


Table 4: Summary of tagged and recaptured fish

Species	Number Tagged		Recaptures (anglers)		Recaptures (PW&U)	
	Previous	2003	Previous	2003	Previous	2003
Smallmouth Bass	1,742	476	76	19	117	30
Walleye	351	161	38	32	9	3
Largemouth Bass	82	19	6	3	4	0

the increase in the number of walleye tagged for the last two years.

Of the 87 recapture events, 39 revealed fish movements (23 downstream, 16 upstream) and the majority of these were walleye (Table 5).

Unlike previous years, walleye that moved tended to go downstream and only a few were recaptured where they were originally tagged. The majority of walleye that did move upstream went less than 3 miles except for a few individuals. Three of these fish made it as far upstream as the Mottville Dam where they were captured and reported by anglers. The upstream moving walleye averaged 4.3 miles, while the fish moving downstream averaged 6.4 miles. Unlike the upstream moving walleye, the majority of downstream moving fish moved more than 5 miles. This was mostly due to the fact that many of the tagged walleye were released below the Johnson Street dam and could not move any farther upstream, so they merely redistributed themselves downstream of the dam once their spawning activities were complete.

As in the past, there was very little movement by the smallmouth bass and most were recaptured near their release point. These fish tend to remain in the areas where they are captured and released. The smallmouth bass that did move averaged 2.2 miles upstream and 3.1 miles downstream. These upstream and downstream movements were greater than the distances moved in 2002 (Foy 2003), but very similar to the distances moved in 2001 (Foy 2002). The most interesting movements were by two fish that were tagged in tributaries (Juday Creek and Christiana Creek) and recaptured in the St. Joseph River. The smallmouth bass that was tagged in Juday Creek

Table 5: Summary of movement of recaptured fish

Direction Moved	Smallmouth Bass	Walleye	Largemouth Bass
No Movement	41	5	2
Upstream	2	13	1
Downstream	6	17	0

was recaptured by an angler a month-and-a-half later in the St. Joseph River upstream of the mouth of Juday Creek. The Christiana Creek smallmouth bass was tagged during the summer of 2002 and then recaptured by us eight-and-a-half

months later near the Johnson Street dam while sampling in the spring for walleye. Interestingly, this same fish was recaptured twice during the summer of 2003 where it was originally tagged in Christiana Creek. This recapture scenario sheds new light on the importance of both the large river and the smaller tributaries in the lifecycle of smallmouth bass.

The single largemouth bass that moved traveled 12.3 miles upstream from where it was released in just 10 days. This is the fastest movement we have seen by a largemouth bass

FISH TISSUE

In 2003, the third year of tissue sampling in the South Bend area was completed. This data (2001-2003) will now be compiled and sent to the state for inclusion in future fish consumption advisories (FCA) for the St. Joseph River and Juday Creek in St. Joseph county. The FCA was also modified in 2003 for the Elkhart and St. Joseph rivers in Elkhart county based on new information the state had collected and on tissue data that had been supplied by Elkhart. All of the modifications reflected lower concentrations of mercury and/or PCB levels in the fish tissue.

In 2001, rock bass tissue collected from one of three newly established sites along the Elkhart River had group 3 PCB levels. This was higher

than any of the other rock bass samples that had been collected from the Elkhart River, so samples were again collected in 2002 and 2003 from this site and one site upstream (Appendix B). These new samples contained group 1 and 2 PCB levels. Golden redhorse tissue was again collected from two locations on the Elkhart River in an attempt to expand the information that is available for the fish species in this river. These samples had group 2 and 3 PCB levels. The rock bass tissue results are consistent with the FCA and the golden redhorse results suggest an advisory for this species is warranted on the Elkhart River in Elkhart county.

On the St. Joseph River in Elkhart County, tissue sampling focused on collecting larger walleye (16+ inches) from the Bristol area and getting additional tissue samples from black redhorse, common carp, largemouth bass and rock bass. The walleye sample contained group 2 mercury and group 1 PCB levels. These findings varied little from previous results (Foy 2003). The 2003 tissue results for the black redhorse, common carp, largemouth bass and rock bass were also consistent with past results (Foy 1999, Foy 2000, Foy 2001) indicating the modifications to the FCA were needed.

Fish tissue samples from the St. Joseph River near South Bend again revealed a variety of PCB levels (group 2-5) and lower (group 1 or 2) mercury levels (Appendix B). Largemouth bass were the only species on the 2003 FCA that were not sampled due to their absence from the catch. Common carp and shorthead redhorse contained the highest PCB levels while golden redhorse, channel catfish and quillback had the highest mercury levels. The 2001-2003 tissue results reveal several modifications are needed for the FCA in St. Joseph county (see Appendix B). Common carp, golden redhorse, and quillback all have varying levels of mercury indicating this contaminant should be included in the FCA for these species. Shorthead redhorse, on the other hand, consistently have higher PCB levels than are indicated on the current FCA, while steelhead and white suckers have lower PCB levels. Updating the FCA with these current results will greatly benefit the anglers who use this information. Likewise, tissue results for white suckers from Juday Creek over the past three years indicate this species could be removed from the FCA for this stream.

CONCLUSION

Long-term biological monitoring along most of the St. Joseph River in Elkhart and St. Joseph counties now provides a useful baseline of information for this watershed. Index of Biotic Integrity (IBI) scores on the St. Joseph River as it flows through Elkhart and South Bend reveal fair to good fish community health. Initial habitat evaluations suggest the fish community health in the St. Joseph River is strongly driven by the quality of the habitat that is available. The IBI scores for 2001-2003 on the Elkhart River better define the established baseline for this river, and the added habitat information indicates that urban impacts (bridges, street run-off, combined sewer overflows, lawn fertilizers, etc.), not available habitat, are probably the biggest influence on fish community condition in this river. Bowman Creek continues to be seriously impacted by the land use practices within its watershed, the urban environment it flows through and periods of no water flow. It also has poor available habitat. Juday Creek's IBI scores, while artificially low due to its cooler water temperatures, are lower than similar streams in the area (Puterbaugh Creek, Pine Creek and the Little Elkhart River). Once a cool/cold water IBI is located or developed, the IBI scores for all of these streams will be recalculated. The IBI and QHEI scores of Lily Creek are indicative of a stream that is categorized as a regulated drain and is dredged on a regular basis. Streams of this type may never have diverse fish communities or high habitat quality due to how frequently they are disturbed. The fish community of Yellow Creek at the US 20 Bypass appeared to be recovering from an unknown water quality impact that had occurred three years ago. Unfortunately it was severely impacted again in the winter of 2002 by a channel maintenance project that produced massive habitat alterations. Fish community and habitat assessments revealed the fish community condition dropped and the quality of the available habitat decreased.

Pine Creek and the Little Elkhart River both have increasing IBI scores as they approach the St. Joseph River. The sites on these streams closest to the river may have artificially higher IBI scores due to the mix of warmwater river fish and cool/cold water stream fish that occurs in these confluence areas. Puterbaugh Creek appears to be stable from site to site. Habitat quality for the Little Elkhart River is good to excellent and very poor to fair for Puterbaugh and Pine creeks. Habi-

tat quality does not appear to be a limiting factor in the stream fish community condition for these three streams.

In 2005, we will begin a pilot project sampling stream insect communities at some select sites on the St. Joseph River and several of the tributaries in addition to the fish community and habitat assessments. By concurrently measuring these three factors, this improved biological monitoring program will provide the most comprehensive view of the health of our stream resources.

In the sixth year of sampling, over 650 fish were tagged and 83 fish were recaptured in 87 events. The number of smallmouth bass and walleye that were recaptured also increased over the previous year. More fish were tagged and recaptured in 2003 than in any other year before! The increase in tagged walleye was due to an extra sampling event in the spring that targeted these fish. Walleye movements were also on the rise this year with thirteen fish moving upstream and seventeen fish moving downstream from their release points.

In 2003, modifications in the Fish Consumption Advisory for Elkhart county reflected lower concentrations of mercury and/or PCB levels based on data Elkhart had provided and new data the state had collected. Golden redhorse tissue was collected again from the Elkhart River and rock bass tissue from this river had group 1 and 2 PCB levels. Juday Creek white sucker tissue continued to have group 1 PCB and mercury levels indicating this species could be removed from the FCA. The results for fish from the St. Joseph River in St. Joseph county indicated mercury should be included in the FCA for common carp, golden redhorse, and quillback and PCB levels in shorthead redhorse are consistently higher than indicated in the current FCA. The data also reveals steelhead and white sucker PCB levels are lower than reported in the FCA. The fish tissue results to date

for the St. Joseph River reveal a pattern of increasing PCB levels as the river flows through Indiana.

The cities of South Bend and Elkhart will continue in their joint effort to document the condition and integrity of the fish communities in the St. Joseph River watershed. With the addition of habitat information in 2003 and aquatic insect community information in 2004, the citizens of these two communities will have invaluable information on the health of the stream resources in their area. All of this information can ultimately be utilized by scientists and policy makers to assist them in their decision making. Local communities working for the betterment of the environment. That's what it is all about!

ACKNOWLEDGEMENTS

A special thanks is extended to the 2003 summer staff (Daragh Deegan, Dan Reiff, Jolyn Rodman, Aaron Liechty, Michelle Weinman, Rachel Jackson, and Erin Lomax) for their efforts to collect and record the vast amount of information that we do in so short a period of time. It is truly a challenge and they got it done!

Thanks are also extended to the Michiana Walleye Association for financial assistance with the purchase of the anchor tags used on the walleye and bass, and to the administration and support staff of Elkhart Public Works and Utilities for their continued assistance and support of this program and their true dedication to the environment.

Last, I would like to thank the cities of Elkhart and South Bend for their leadership in the area of aquatic resource protection. Through the establishment of an interlocal agreement between these two cities, information is now being collected to help preserve and protect a shared aquatic resource, the St. Joseph River.

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SUMMER 2003



Jolyn with a nice smallmouth bass



Summer Crew:
(front L-R) Michelle, Rachel, Jolyn
(back L-R) Daragh, Dan, Aaron, Erin



Rachel with a 5 lb. walleye at the Riverwalk in Elkhart



A bowfin (dogfish) in breeding colors



Dan & Rachel with a few nice smallmouth bass from the St. Joseph River in South Bend



Erin with a 4.8 lb. largemouth bass from the Elkhart River



Michelle with an 8 lb. northern pike from the Elkhart River near Goshen



A greater redhorse from the Elkhart River



Aaron with a longnose gar